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Shipping Policy

THE lack of a definite shipping policy cannot be justly blamed on Congress, which over a year ago passed shipping legislation, the enforcement of the crux of which has not yet even been attempted. Congress very wisely foresaw that shipping as well as other industries required protection and that it was a case of imposing discriminatory duties or granting direct subsidies. The result has been, and also would have been even if the Shipping Board were the most efficient organization on earth, that government vessels have been allocated and chartered on terms which amount to nothing more or less than a heavy subsidy.

Most important, however, is the fact that lacking a shipping policy which would be attractive to investors in marine securities, either of the systems of bare boat charter or allocation must be placed on such attractive terms that there is always a grave danger than possible investors will consider it a better bargain to charter than to buy outright. This, of course, is contrary to the avowed intention of having our merchant marine owned and operated by private citizens and, at the same time, it is placing a subsidiary burden on the country which cannot fail to create a general opinion very detrimental to the successful development of the shipping industry.

Proposed Fees for Steamboat Inspection

ALTHOUGH the preamble of the Jones Act declares that the United States is determined to develop an adequate merchant marine, it appears that some of our congressmen must be lying awake nights devising additional burdens and obstacles to defeat this purpose. Not content with the restriction of immigration and the prevention of the sale of liquor in American vessels on the high seas, it is now proposed to saddle the expense of supporting the Steamboat Inspection Service on the merchant marine.

As an excuse for doing this it is pointed out that the Patent Office is supported by fees and also that the Steamboat Inspection Service in the early days was not only supported by such a system but was also able to accumulate a large surplus. It is further claimed that the Government ought not to render services free to one industry and at the same time charge another. But, what is the nature of the Steamboat Inspection Service? Is it not for the purpose of safeguarding life rather than property and does it not concern itself more about safe boiler pressures and lifesaving equipment than the structure of a vessel? Finally, does not the shipowner have to rely on the rules and surveys of the classification societies, which are supported by fees, in order to obtain insurance on his property?

The man who patents his own invention or the man who sends a letter should be quite willing to pay for the service rendered him, but the Steamboat Inspection Service is for the benefit of the general public and it should be classed in the same category as lighthouses, fog horns and other aids to safe navigation.

Buy Ships Now

ACCORDING to one of our English contemporaries the history of the British mercantile marine convincingly indicates that those companies which have invested largely in tonnage during a boom period have generally met with disaster resulting either in a failure or a reduction in capital. On the other hand, it has been almost invariably true that the fleets purchased during a slump have been successful. The main reason for this has been that the men who have bought in dull times knew the game and realizing that as ships must continue to sail the seas it was a good policy to purchase them when the prices were, as now, way below the cost of construction.

The best kind of a tip that now is the time to buy ships has been furnished by the example of Captain Robert Dollar who has recently purchased several vessels for his line. Captain Dollar's ability as a ship operator is universally acknowledged, in fact he is often spoken of as the dean of our shipping men, and in view of his long and successful experience it is a safe bet that he knows when to buy ships.

There can be no doubt that both Congress and the new Shipping Board now realize that the greater part of the original cost of our Government fleet must be written off as a war loss, and rightly so, for they were constructed for the defense of the nation. To saddle this burden on shipowners, if this were possible, would mean their ruin and ultimately great harm to our merchant marine, whereas the whole country will benefit if those interested in investing in shipping enterprises are given a fair chance of making good.

It is encouraging to note that Mr. Lasker's first statement indicates that the new Board will adopt the broad policy of

considering the best interests of American shipping as a whole in liquidating the Government merchant marine rather than the possibility of making a good financial showing through the sale of vessels at war prices. With this in view prospective purchasers of vessels should make a careful study of the price they can afford to pay for tonnage with a reasonable margin for profit and this amount should be as far as possible supported by figures which if necessary can be submitted to the Board in proof of their contention.

Disarmament

WHILE there are at least thirteen reasons why an inebriate should never take a drink it is usually the case that when he gets an opportunity to indulge he is generally unable to think of one of them. This would not be so serious in itself if the results of his actions did not affect the liberties of those who possess the sense and faculty of avoiding intemperance. It is hard to sympathize with a man, who, knowing by experience the horrors, degradation and poverty that the excessive use of liquor is sure to bring upon him, still persists in drinking. His conduct, however, can be accounted for as a disease.

But what can be said of sane and supposedly intelligent people, having full knowledge of what was done to Belgium, the sinking of the *Lusitania,* the devastation of France, aye, the great suffering that still exists as a result of the inability of civilization to defend itself against a nation crazed with the lust of conquest, who can and dare to advocate making the country defenseless except for treaties which so easily become "scraps of paper?"

There are twice thirteen good reasons why this country should insure itself against a foreign soldier ever putting his foot on our soil. Let no one deny the possibility of war while such affairs as the Tulsa race riot occur in our own country. But this can only be accomplished by a powerful and efficient navy. Ships of war cannot occupy foreign countries but they can fight offensively or defensively far enough away from our shores to prevent the destruction of our seaports. Both administrations have endorsed our present naval program, but there is a disarmament string tied to it, and "lest we forget" what "pussyfooting" has accomplished in the past, it is well to watch these birds of paradise on earth for they may fly away with our battleships as they did with our schooners.

Panama Canal Tolls

IT is encouraging to note that the Senate Committee on Inter-Oceanic Canals has unanimously voted to report favorably to that body Senator Borah's bill which provides that no tolls shall be charged to vessels passing through the canal which are engaged in the coastwise trade of the United States. Although Senators Jones and Poindexter have introduced measures providing for the exemption of all American vessels from the payment of these tolls it was felt that the Borah bill had a much better chance of success as no treaty complications were involved due to the fact that only American vessels can engage in the coastwise trade.

The importance of this action at this time is particularly significant in view of the growing freight trade for our merchant marine between the Pacific and Atlantic coasts in the carriage of fruit, eggs and vegetables. A representative of the Pacific Producers' Association, which symbolizes over $300,000,000 of invested capital, and also vice-president of the California Fruit Growers' Exchange, was recently in conference with New York steamship companies to arrange for refrigerated space to carry fruit and vegetables on this route. He claimed that the consumer fixes the price and that it was the hope of the institutions that he represented that the water route would solve this problem.

The Panama Canal tolls are a direct tax on our commerce and this repeal would do much to increase the trade of the Pacific coast. As America acquired title to the land upon which the canal is constructed, paid for all the work that was done on it and is solely responsible for its maintenance, there does not seem to be any reason either in law or equity why American vessels and at least those engaged in the coastwise trade should not be exempted from the payment of tolls.

Pioneer Purchasers

THOSE American firms who were courageous and patriotic enough to purchase American tonnage from the Shipping Board at prices in the neighborhood of $200 a deadweight ton are deserving of very favorable consideration in connection with the readjustment of the sales policy to be adopted by the Government. To hold these pioneer buyers to their original contracts of $200 a deadweight ton and at the same time supply the market with ships at $50 a deadweight ton would be a very short sighted policy from a business standpoint. It would be certain to ruin or severely handicap a large percentage of a class of men upon whom America must depend to build up our merchant marine successfully and, furthermore, it would do this at a time when it is acknowledged that we have no experienced ship operators to spare.

The Government has really, if not legally, failed to live up to its part of these contracts as no action has been taken to put into force the protective features of the Merchant Marine Act which was approved June 5, 1920. In view of the exhaustive hearings and debates that preceded the passage of this Act it is not reasonable to suppose that ships were purchased whether before or after its approval without due consideration of its important features and even if they were it does not alter the fact that shipowners have not received the benefit of the protection specified in this law or anything equivalent to it.

No doubt the new Shipping Board fully realizes that close co-operation between the Government and private shipping interests can be obtained only by fair treatment. It is not fair to compel the pioneer purchasers of Government vessels to pay four times the capital interest, depreciation and insurance charges that are to be required of new buyers. If these gentlemen made a mistake in purchasing when they did, they at least showed the right spirit, and it should be remembered that those who never make mistakes never do anything. What we need in our merchant marine today is men who can do something, men who are not afraid to take the helm no matter how many mines or torpedoes lay in the channel.

The Newly Appointed Shipping Board

Left to Right—Meyer Lissner, Los Angeles, Cal., Republican, Representing the Pacific Coast States; Rear-Admiral W. S. Benson, U.S.N., Atlanta, Ga., Democrat, Representing the Atlantic Coast States; T. V. O'Connor, Buffalo, N. Y., Republican, Representing the Great Lakes States; Albert D. Lasker, Chairman, Chicago, Ill., Republican, Representing the Interior; Hon. George E. Chamberlain, Portland, Ore., Democrat; Representing the Pacific Coast States; Frederick I. Thompson, Mobile, Ala., Democrat, Representing the Gulf States, and Edwin C. Plummer, Bath, Me., Republican, Representing the Atlantic Coast States.

Back Up the New Shipping Board

Cut Out Knocking, Get Together and Boost the American Merchant Marine

THE long expected, anxiously awaited, new Shipping Board is here at last. A little over one year from the date the Jones bill became law, seven men have been selected who will form a functioning board and it is high time for them to begin functioning at the earliest possible moment. The board, as selected, is not such as many people would desire and, like its predecessors, it is conspicuous for the absence of real shipping men. It is possibly more political that practical but, such as it is, it seems to be the best that the new executive could get together after over two months' endeavor. It is not his fault that men of the Farrell and Teagle type are not to fill these positions. They certainly were given every opportunity to serve their country in this critical time, for maritime matters.

So let us all who are interested in the American merchant marine extend a welcoming hand to the new members and resolve that henceforth we will back them up, aid them in their endeavors to keep our ships on the seven seas and make it profitable for us to do so. It is a stupendous undertaking and one worthy of our very best endeavors. Seemingly ever since the Shipping Board was first started back in 1917, it has been a source of turmoil, a butt of ill advised jokes and a target for criticism. No other branch of the Government has been so continuously in the public eye through the daily press and the torrents of ridicule, complaints and criticism have, it is quite apparent, shaken the faith of both Congress and the people in the ultimate success of our new venture on the seas after over half a century of atrophied foreign commerce. This is sincerely to be regretted, as the task of rehabilitation is in itself so herculean that there is little time to spare for anything else. Now, in addition to the tasks which would ordinarily confront the new board, it will be necessary for them to stem the tide of adverse criticism which has become so popular in Congress and in the public

press. There is where the thorough political training of several of the new members will come in good stead.

The regular problems awaiting the earliest action of the board will require very skilful handling and the two members remaining from the old board should prove invaluable with the experience which they have already gained. In spite of the popular clamor on all sides for the Government to dispose of the fleet at once and get out of the shipping business as soon as possible, the board will soon find that such procedure is an absolute impossibility and it may as well make up its mind that the Government will have to continue to retain ownership in the greater part of its immense fleet for not only one or two years but in all probability for from five to ten years, depending largely upon how long it will take the country to return to normal business conditions. The next best thing, after the matter of retaining ownership is settled, is for the Board to determine how best the ships can be used with as little government operation as possible. It is more than probable that a liberal form of bare-boat charter will furnish the best medium for operation. Make the terms of the charter so liberal that shipping men can operate our now half idle fleet in competition with the ships of other nations and be able to make living profits in direct proportion to the skill of their management.

What is the use of talking about selling the ships to the public? When three fine ships like the *Marica,* built in 1919, get bids of only $20 per deadweight ton from the highest bidder in open competition, what would result if 10,000,000 tons of shipping should suddenly be dumped on the market? The most fortunate thing that has yet happened to our aspiring merchant marine was when the Shipping Board resolutely kept the sale price of its ships around $200 per ton, when experts were clamoring to have them put on the block at what then seemed to be the absurdly low price of $100 per ton. If the whole of the fleet, or even a goodly portion of it, had been sold to private parties at even that low price, the country today would be full of bankrupts and our merchant marine activities would have received such a setback as could not be overcome in many years. Uncle Sam is the only one strong enough to hold the bag during this world wide slump in shipping matters.

Much groaning is indulged in by members of Congress at the large deficits which the operation of the ships is rolling up. As a matter of fact, if the wage question could be settled on a basis commensurate with existing economic conditions, it is doubtful if there would be much of a deficit, despite the extremely low freight rates now being received by the vessels in operation. Slowly but surely this, the greatest single business operation on earth, has been systematized and good management has replaced to a large extent the chaotic and extravagant methods heretofore encountered in everything connected with Government operation of these ships. Most of the errors of omission and commission of the Shipping Board can now be spoken of in the past tense notwithstanding the absence of a full and functioning membership of the Board for over a year; the responsible heads of the several leading divisions have laboriously kept at their tasks and have cut out waste to a surprising extent.

The very efficient management of the construction and repair division has resulted in the removal of inefficient employees and the reduction of repair bills to a very agreeable and surprising extent. The repair bills on the Board's ships at the present time will compare very favorably with those of privately operated ships. The purchase of the vast quantities of supplies necessary for the operation of so many ships has been systematized so that now quantity purchasing is the rule, with the very gratifying result of great savings when compared to the previous haphazard purchases for individual ships or groups of ships.

It seems to be a weakness of Americans to build up some vast enterprise, gloat over our accomplishment for a brief period and then, when some minor faults are found in the structure, begin, figuratively speaking, to throw bricks at everything that has been done, investigate everything in sight and berate everybody connected with it. We have all indulged in this program with the Shipping Board and its activities until the inevitable reaction is long overdue. Let us all swear off on further criticism and each in his particular function start in to help the new Board, help the officials and help everything connected with our shipping enterprise. Give those who have stuck to their jobs and brought order out of chaos due credit for what they have done and encourage them to keep on improving. Forget the wooden ships: they have had enough anathemas already heaped upon them to sink them in the sea of oblivion, if not in the briny deep. Let some of us, somewhere, try and devise some legitimate use for these stepchildren of the Shipping Board. They are not altogether illegitimate children but they have been treated that way thus far.

The Jones bill now over a year old has not yet been given a trial. Many of us firmly believe that its provisions are ample to keep our merchant marine on the seas. Let us all get together and give it a good thorough try out, annul the conflicting treaties, put the preferential duties into operation and try out every other provision of this fine piece of legislation. If at the end of, say, two years fair and impartial trial, we find that we cannot keep our fleet on the seas in competition, then let's find out what is necessary and go get the additional legislation necessary.

We must never falter in the idea that we have got to maintain this merchant marine. As so often repeated, we are now a manufacturing nation and we must sell the twenty percent of our surplus manufactured goods or as a nation we will fall down in the struggle for existence. We cannot sell this surplus unless we have our own ships to deliver our goods to our customers direct. There must be no weakening in our efforts either, as we are playing the game with some very live and earnest seekers for the world trade.

Let me repeat again: Cut out this senseless knocking, get together and all begin boosting for what we must have—an efficient American merchant marine.

SHIPPING BOARD TO APPOINT DIRECTOR OF OPERATIONS.—The newly appointed Shipping Board is now directing its attention largely to matters of organization and personnel and is expected to announce before long the appointment of a new director of operations, who, in common with other appointees of the board, will be a man eminently qualified by training and experience to direct the work to which he is assigned. The board has issued an order that there shall be no sales of surplus materials amounting to over $1,000 without being referred to the board.

The New Chairman of the Shipping Board

Albert D. Lasker, Executive and Organizer, Takes the Helm, Assuring a Straight Business Course for Shipping

THE new chairman of the Shipping Board does not know a ship from the keel to the main truck, but he knows business from the office boy to the president—and a business administration of our Shipping Board is of first importance. Mr. Lasker will proceed like any other executive of ability by hiring the very best men he can find as heads of the several functioning departments of the Shipping Board. In other words, besides his associates on the Board, Mr. Lasker will employ a staff of experts to carry on the actual work of building, maintaining and operating vessels until such time as the Board will undoubtedly and by gradual process turn over its ships to private interests.

Albert D. Lasker

The ultimate outcome will in all probability be that the Shipping Board will eventually confine itself to matters of policy, investigation of the relative costs, advantages and disadvantages of operating American vessels in the foreign trade as compared with vessels under foreign registry, investigating the navigation laws for the purpose of advising Congress as to what revisions are needed to develop our merchant marine and to functioning as a regulating body similar to the Interstate Commerce Commission.

Albert D. Lasker is an advertising man who is well known to publishers and business men. Ever since he went to Chicago as a boy from the Lone Star State and started his career as office boy and stenographer in the Lord & Thomas Advertising Agency he has made a success of every undertaking. His first promotion placed him in charge of the correspondence of a minor section. Next he took charge of that department and then in a short time a more important department was placed under his supervision, but right here it should be stated that while Mr. Lord recognized his exceptional ability, his capacity for hard work and his natural hustling tendencies played no small part in his success.

As his value to the firm kept increasing he was offered a junior partnership and a few years later when the original partners retired he assumed absolute control. Since Mr. Lasker became "Lord & Thomas" the business has been expanded to proportions never dreamed of by its former owners, but to relate all the achievements of the man who made "Spearmint" a household word would take more space than we have available.

The Shipping Board is one of if not the most difficult of our problems today and surely one of the most vital to the prosperity of our country. But in Mr. Lasker we have a man about 40 years of age who can and will work 16 hours a day, who makes rapid decisions and refuses to be blocked by red tape or details. He is very democratic with a pleasing personality which gives you the impression whether you know him or not that he is glad to see you. Mr. Lasker is a part owner of the Mitchell Motor Company, Van Camp Packing Company, Chicago Baseball Club and the Quaker Oats Company. He was closely identified with the Republican National Committee, during and prior to the recent presidential campaign. President Harding has spoken of him as one of the livest wires in the country and with everything to lose and little to gain; for public service rewards are never what they should be. It is certain that the new chairman will do his best to develop a merchant marine that will be a source of pride, protection and prosperity.

A special message from Senator Wesley L. Jones, author of the Merchant Marine Act of 1920.

The George Washington

AMERICANS should travel on American ships as a patriotic duty. They should be willing to suffer some inconvenience in time and accommodations to do this. With the sailing of the **George Washington** for Europe on July 30 a new era in American shipping dawns on the Atlantic. She is a first class passenger ship of great speed. So long as she sails and has accommodations, no American will have any excuse for sailing on an alien ship. I trust she may be the forerunner of an adequate fleet of high class passenger ships crossing the Atlantic under the American flag.

Such ships maintain our commerce in peace and defend us in war. They are a striking symbol of America's greatness in every foreign port where they drop anchor. In commercial and industrial pursuits the United States stands without a peer. We have many vessels under the American flag. We are going to have a permanent, adequate American merchant marine. No minor portion of this will be constituted of passenger and combination passenger and freight liners. Vessels of the type of the **George Washington** will follow rapidly with the upbuilding of our merchant marine but we must give them support.

We can point to no greater mark of our maritime progress than the maintenance of a fleet of passenger vessels of the most efficient type furnishing regular service between the ports of the world and sailing under the American flag.

Steamship George Washington, Refitted as American Liner

American Passenger Liner George Washington

Giant Twin Screw Vessel of 25,570 Gross Tons to Be Flagship of American Fleet

By Col. George Crouse Cook*

JULY 30, 1921, will mark an important event in the annals of our merchant marine for on that day the *George Washington* will sail from New York on her first voyage under the flag of the United States Mail Steamship Company for Plymouth, Cherbourg and Bremen. They are working night and day at the Tietjen & Lang plant of the Todd Shipyards Corporation to get this big vessel thoroughly overhauled and reconditioned. Until the *Leviathan* is placed in commission, this will be the flagship of the American fleet. This job is a great accomplishment in itself, not only because every piece of equipment that is used in the reconstruction is of American origin, but also because it shows that we are capable of doing this class of work as well if not better than foreign shipyards and certainly in much quicker time.

Over a hundred thousand soldiers were transported by the *George Washington* during the war, and in addition it was used by President Wilson and his suite for both voyages to the Peace Conference at Versailles, the King and Queen of Belgium upon their visit to the United States and many other notable travelers. By virtue of these facts it has become one of the most famous passenger vessels afloat and each of its leading suites and staterooms is associated with names which are familiar not only in this country but throughout the entire world.

Commodore W. H. Bevan

The *George Washington* will be under the command of Commodore W. H. Bevan, the senior captain of the United States Mail Steamship Company's fleet, who has been a captain for fifteen years, and it will be the seventeenth vessel of which he has had command. Commodore Bevan was a lieutenant commander in the United States Naval Reserve during the war, and he was the first marine superintendent for the Shipping Board when it took over the German fleet. He not only helped put the ex-German ships into condition, but took command of one of the first vessels which carried war materials to France. This vessel had neither guns nor wireless equipment but Commodore Bevan took her across safely, although for twelve days he never took off his clothes or his shoes.

Safety Precautions

Commodore Bevan states that every known safety device will be employed on this vessel. He will have a staff captain who will always be available to take command in case of accident or sickness to him and all the senior officers are men who have commanding experience. The commodore is particularly proud of the fact that when the *George Washington* leaves America she will be fully equipped for the round trip with the exception of about 300 tons of

*Naval Architect, United States Mail Steamship Company.

Social Hall

View of Suite De Luxe

Children's Play and Dining Room

First Class Dining Saloon

American Passenger Liner George Washington

General Information

Service: New York, Plymouth, Cherbourg and Bremen.
Builder: Vulcan, Stettin, Ger. Reconditioned by Tietjen and Lang Dry Dock Co.
Owner: U. S. Shipping Board.
Operator: U. S. Mail Steamship Co.

Characteristics

Length, overall .....722′ 5½″
Length, B. P. .....700′ 0″
Breadth, molded .....78′ 0″
Depth, molded .....44′ 9″-54′ 0″
Draft loaded .....33′ 0″
Draft, light .....23′ 9½″
Block coefficient .....
Midship section coefficient .....
Longitudinal coefficient .....
Speed, loaded, knots.....18
Cruising radius, nautical miles 8,000
Framing .....Transverse
Class .....American Bureau A-1

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull .....
**Weight Propelling Machinery .....
Deadweight Capacity .....13,465 tons
Displacement 36,000
(In tons of 100 cubic feet)
Gross register 25,570
Net register 15,379

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.
**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez		
Panama		

Equipment

Anchors: 3 Bowers .....at 18,800 lbs.
1 Stream .....at 6,600 lbs.
1 Kedge .....at 3,300 lbs.
.....
Chain: 2 Bower chains, 3½″, 164 fathoms
.....
.....
.....

Rudder

Area .....
Dia. Stock .....
C. Press. abaft C. L. pintles .....

Complement

Deck Officers 15
Deck crew 109
Engineer officers 7
Engineer crew 191
Purser's and steward's department 373
Total officers and crew 695
First-class passengers 573
Second-class passengers 442
Third-class passengers 1485
Total passengers 2508
Total complement 3203

Handling Equipment

	No.	Type	Capacity	Length
Masts	4	Pole	....	....
Derrick posts	....	....	....	....
Booms	....	....	....	....
Discharging Capacity				

Deck Machinery

(Number, Size, Type)

Steering Gear .....One main steam
.....One auxiliary steam
Windlass .....
Capstans .....
Winches .....
.....

Life Saving Equipment

	No.	Capacity
Lifeboats	45	2720
Rafts	25	600

Propelling Machinery

Boilers

Number .....8 DE & 4 SE
Type .....Scotch
Length .....
Width or Diameter .....
Furnaces 60
Fuel .....Coal
Draft .....Forced
Total heating surface, square feet: 52,493.6
Total grate surface or furnace volume ....
.....1,225.52 sq. ft.
Superheat, degrees F. .....
Working pressure, lbs. per sq. in.....213
Normal fuel consumption:
Per day, tons 361
Per horsepower hour, pounds .....
Normal steam production:
Per hour per pound of fuel....lbs.
Total per hour .....lbs.

Engines

Number 2
Type .....Quadruple Expansion
Size .....38.2″ x 56.7″ x 79.9″ x 112.2″
Horsepower 21,000

Propellers

Number 2
Type .....Built-up
Weight .....
Diameter .....21′ 4″
Pitch .....24′ 11¼″
R. P. M. 83
Projected area .....
Developed area .....

Auxiliary Machinery

(Number, Size, Type)

Machinery Space

Condensers .....
.....
.....
Evaporators .....One at 30 tons
Distiller .....
Filters .....
Feed water heater .....
Fuel oil heaters .....
.....
Pumps:
(6) Main feed
(3) Sanitary
(2) Ballast
(1) Fire
(3) Aux. feed
(2) Bilge
(1) Evaporator
.....
.....
.....
.....
.....

Refrigerating Machinery
Two CO_2 at 30 tons
One CO_2 at 7 tons

Electric Equipment
Generators ..Six at 110 volts, 1,000 amperes
Radio .....One at 6 KW. and one at 25 KW.
Emergency .....One

Holds

No.	Length	Hatches

Capacities

Cargo Space

Compartment	
Decks and holds	232,000 cu. ft.

Refrigerated Space

Compartment	Cu. Ft.
Stores only	517 tons

Bunkers

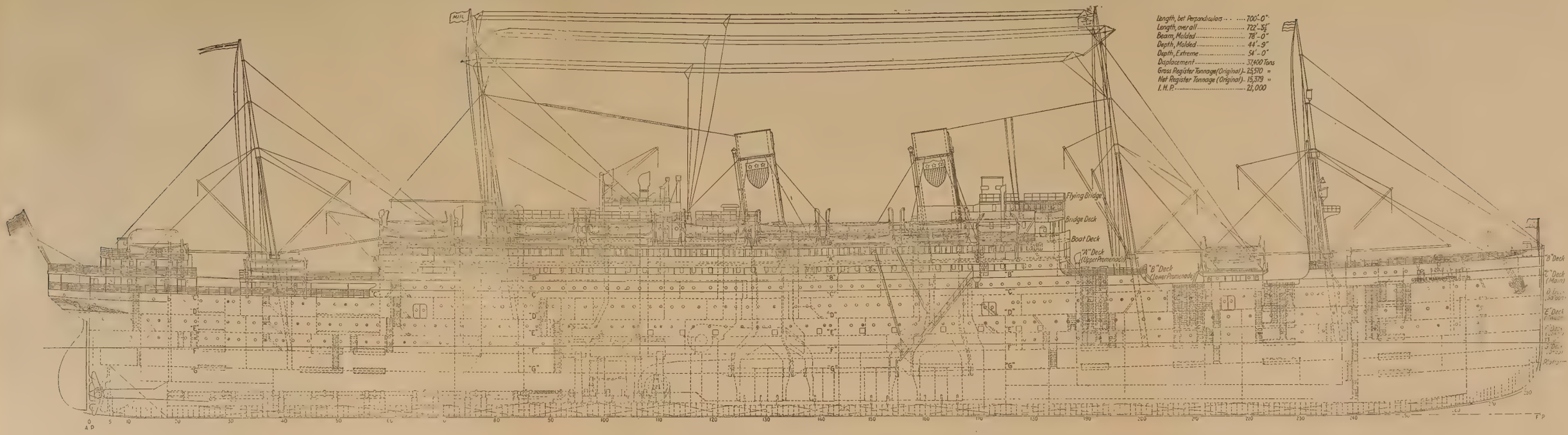
Compartment	Cu. Ft.	*Bbls.	*Tons
Permanent			3,913
Reserve			849
Special reserve			1,800

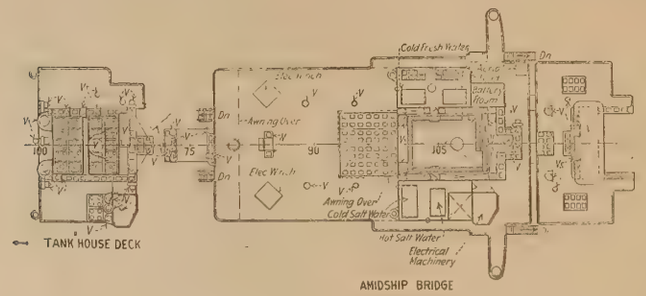
*....cu. ft. per ton;.....gals. per bbl.

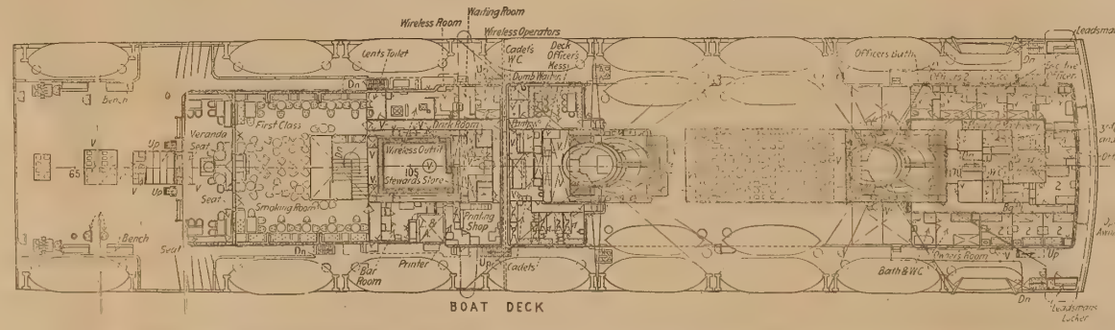
Tanks

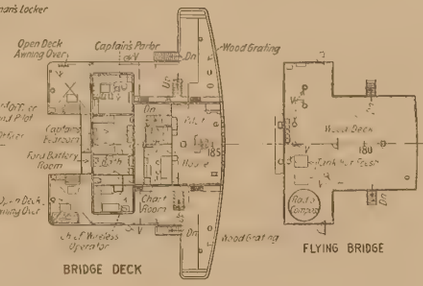
Compartment	Cu. Ft.	Tons F. W.	Tons S. W.
Fresh water			2,100
Total			

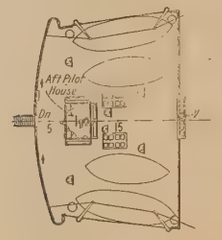
THE AMERICAN PASSENGER LINER GEORGE WASHINGTON

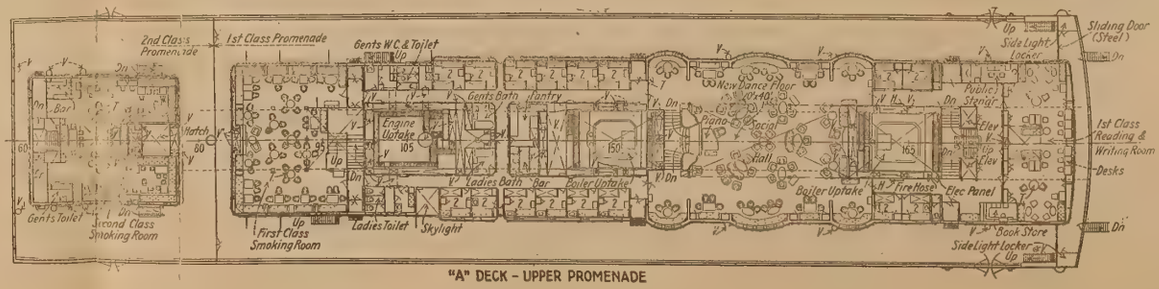






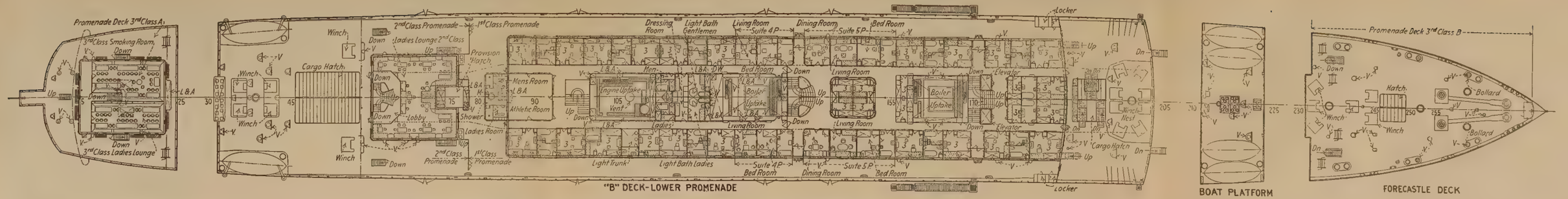


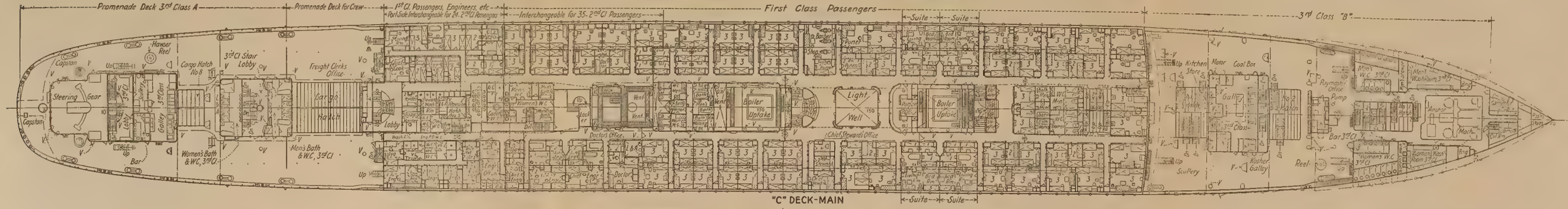


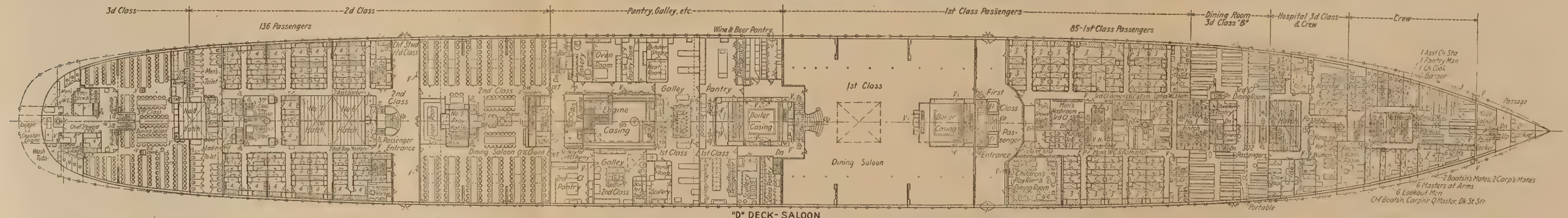


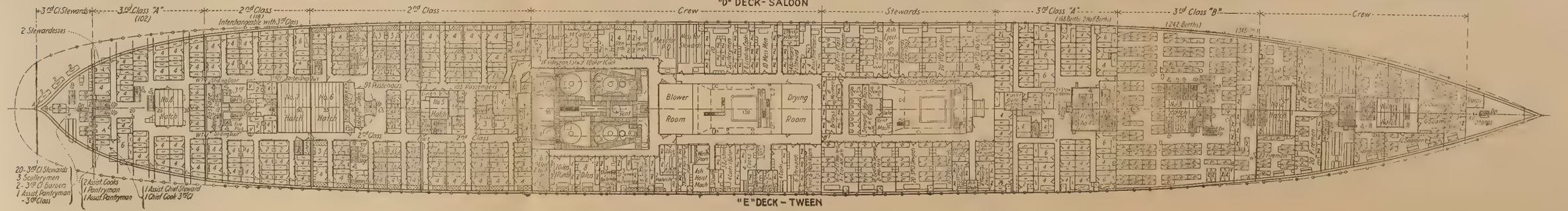
Profile and Upper Deck Plans

THE AMERICAN PASSENGER LINER GEORGE WASHINGTON









Deck Plans

coal and that all her stores will be purchased in our own country.

Safety has been given even greater consideration than luxuries in the equipment and outfit of the vessel. Every invention for adding to this vital element has been studied and, where practical, installed on this vessel. Among these inventions the radio compass, which was developed during the war for detecting the direction of the origin of radio signals, has been adapted in order that the bearing of such signals sent from shore stations may be definitely determined and the position of the vessel itself correspondingly located.

The Gyro-Compass

The *George Washington* is equipped with one of the latest type Sperry gyro compasses. This equipment comprises the master compass and three repeater compasses, one of which is located in each wing of the bridge and one at the wheel for steering. The repeaters on the bridge are mounted in pelorus stands and take the place of the old dummy pelorus. The cards in these repeaters are kept adjusted from the master compass to the true north at all times, so that accurate and true bearings can be taken at any time regardless of the ship's head. This means more to the captain of a vessel than can be described in this limited space.

The vessel is also equipped with a recording compass, which makes a permanent record of all the movements of the ship's head and makes possible the checking up of quartermasters and any changes of course which it is desirable to record.

The more usual items of equipment, such as radio, watertight subdivision, boat equipment, etc., have been perfected in the highest degree and the radio plant, consisting of the most powerful arc light installation afloat is able to communicate with either shore from any position in the Atlantic while its maximum range under favorable conditions is approximately 7,000 miles.

Watertight doors throughout the vessel are operated by hydraulic distant control from the navigating bridge and may be instantaneously closed as a whole or individually, as may be necessary in cases of emergency.

Fire Detection and Prevention

The *George Washington* is equipped with one of the most complete and modern fire alarm systems available today. Saloons, card rooms, passenger and crew's quarters are all protected by the system furnished by the Aero Automatic Alarm Company. Fine copper tubing on the ceilings of these rooms are the detecting elements of this system. Their operation is unique in that it is not necessary for the heat from a fire to reach a high temperature before operating the system. All that is needed is that there be a sudden rise in temperature in the room and the air confined in this fine copper tubing will expand, actuating the diaphragms. This principle makes the system extremely sensitive and no fire, no matter how remote or small, can gain any headway without the alarm being sounded in the engine room and on the bridge. The system is absolutely automatic and ready for service at any hour of the day or night.

The holds of the vessel are equipped with the latest improved type of the Rich Smoke System. This device is an extension of the steam smothering system required by law which consists of a series of pipes leading from the boilers to all enclosed compartments and holds of the ship. This fire detecting system, by means of a small exhauster, draws air samples continuously from every compartment and hold and thus conveys the first traces of smoke to a detecting cabinet in the wheel house. The smoke is revealed in the flares of the detecting cabinet immediately and definitely locating the fire during its incipient stage.

By operating the proper valve steam, or carbon dioxide if desired, can be directed to the specific location of the fire and through the same piping. With the closing off of the steam valve the indicating line is again reestablished and detection continues unharmed by the action of the previous fire.

General Arrangement and Scheme of Decoration

All details of the modern metropolitan hotel have been introduced into the new arrangements of this remarkable vessel and owing to its great size and corresponding steadiness the traveler will find himself, when afloat, in comfort equal to that of the most luxurious home.

The general arrangement of the interior has been allowed to remain somewhat in accordance with the original layout during its operation by the Germans but the details of the decorative features throughout have been refined and modernized in conformity with the best American practice.

Specially trained joiners, cabinet workers and decorators have been brought together from all parts of the country and the quality of their workmanship proves that it is not necessary for us to go abroad to secure the most elaborate cabinet and inlay work. The very choicest of woods have been obtained from all parts of the world and there is scarcely a material used in decorative art which does not in some place find its use in the scheme of the design of this vessel. There are to be found the various classes of mahoganies, teak, satin wood, ebony, maple, walnut, etc., which are in their respective places set off by inlays of other woods, mother of pearl and metallic decorations in order to enhance the effect of the whole.

Tapestries, brocades, silks, satins, velvets, plushes, together with leather, handworked in all forms and styles, are used throughout to supplement and complete the work of the cabinet makers.

Carpets and rugs of domestic manufacture and oriental weaves have been brought together from the choicest markets of the country in order to complete the floor coverings in all public spaces and private rooms. The decks and all passageways and public spaces have also been covered with composition tilings of the highest quality and serve to brighten and finish surfaces where exposed about the margins of floor coverings and rugs.

General Design

The general scheme of decoration varies with different sections of the vessel, but in general may be designated as that of a Continental character with variations and adaptations of the Colonial and Georgian periods which are drawn together to form a harmonious whole. Many of the paintings on the vessel are of American Colonial historical interest and represent scenes connected with the early days of our Republic, such as the Centennial Hall in Philadelphia, the home of Washington at Mount Vernon, various scenes about the National Capital and views of both early New York and Boston.

Bronze and marble figures and busts adorn various niches throughout and include the men and women of Colonial fame, such as Washington, Martha Washington, Franklin and others.

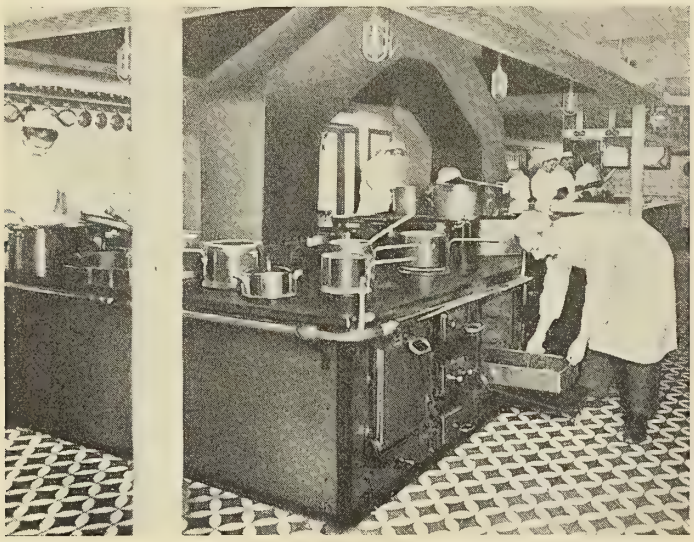
The lobbies about the passenger elevators leading to the grand social hall are tastefully finished in rectangular panels outlined with delicately-tinted moldings and appropriately decorated. The elevator enclosures consist of hand-wrought iron screens and the floors of the lobby within the limits of the vestibules are well tiled and laid with heavy rugs.

Accommodations—First Class

Accommodations for 573 first class passengers are provided, each perfect in its appointment for convenience and comfort but varying in degrees of luxury and spaciousness. The first class accommodations are distributed through five decks and are served by electric elevators which give every comfort and convenience in reaching the various rooms and the main dining saloon.

Cabin staterooms and suites are interconnected by a telephone system of the most modern approved American design and practice and the passenger may communicate throughout with the various officers, stewards, etc., without leaving his own room. The wireless telephone has also been installed and it is possible to stand upon the vessel and communicate by word of mouth with other similarly equipped vessels or shore stations at a distance of approximately 500 miles. The installation is fitted with amplifiers in order that speeches, music or other sounds may be received at their origin in a lecture hall or theatre and heard by all gathered in a dining room or other public space on the vessel.

Aft on the boat deck are the enclosed verandah-cafe, the first class upper smoking room, the radio telephone and tele-



First Class Galley

graph office, the photographic dark room, newspaper office and similar spaces of general public interest.

The upper promenade or *A* deck is glass enclosed throughout and assures open spaces for exercise and recreation independently of weather conditions.

Reading and Writing Room

An unusually spacious and beautifully decorated reading and writing room is situated on the *A* deck well forward, and offers an unobstructed view ahead and to port and starboard. In addition to its permanent loan collection of the finest literature, it contains a magazine and book store and the offices of the public stenographer.

The reading and writing room is finished in natural satinwood, inlaid with ebony and mother of pearl, developed along the lines of the Continental style. The cabinet work about the room consisting of writing desks, book cases, cabinets, settees, etc., are executed with extreme skill and certain doors are decorated with elaborate hand-wrought wood and metal grilles and screens to harmonize with the whole. The portable furniture and tables are constructed and upholstered to correspond and complete the room in a most exquisite style.

Grand Social Hall

The grand social hall, which is the largest individual public room on the vessel, is located on the *A* deck right aft of the reading room and consists of a main central portion and four anterooms or bays. The central portion of the floor is covered by a large hardwood dancing area which, when not being used, is covered by heavy rugs. This room is finished in shades of felted French gray and decorated with a series of paintings of Colonial American interest including a well known portrait of George Washington which is mounted over a Colonial fireplace of exceptionally artistic design.

The skylight, which covers the entire central area of the room, is of heavy leaded glass in simple and appropriate artistic design illuminated by numerous electric lights providing for an indirect system of illumination.

The fireplace and mantel at the head of the room are exceptionally complete and correct examples of the Georgian period.

A grand piano, settees, party and individual tables, social and winged arm chairs upholstered in tapestry and brocades are placed about the room and form a convenient and attractive setting.

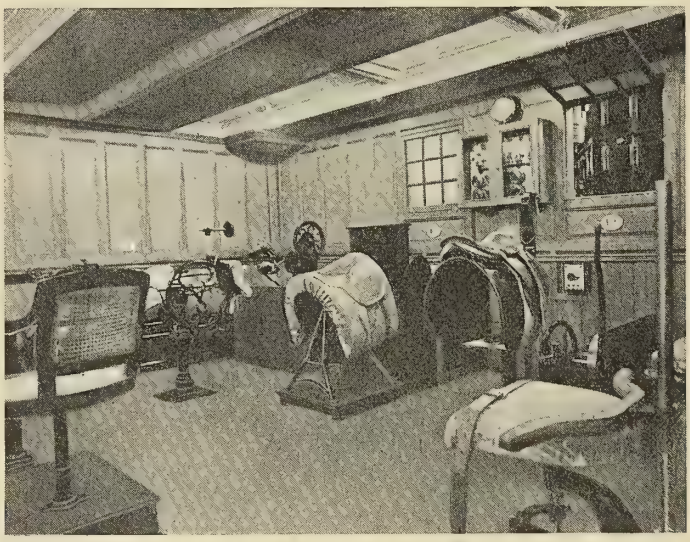
Each of the four anterooms, which are separated from the main area of the hall by panel work and heavy brocade hangings, is developed in an individual style in natural mahogany, walnut, etc., and the walls finished with silk panels matching the natural woodwork. Suitable tables, settees, and chairs are furnished and the spaces form as charming nooks for card parties, luncheon or tea service as may be desired

At the aft end of the grand social hall is a monumental stairway which is finished in felted grays to match the colors of the room and which leads directly to the foyers of the de luxe suites on the deck below. It is ornamented in a simple style of panel work and mirrors and a clock on the electric time system of the vessel.

First Class Lower Smoking Room

The lower smoking room which terminates the first class passenger accommodations on *A* deck is finished in natural walnut inlayed with ebony.

The walls of this room, above the line of settees, are decorated in embossed, hand worked leather in rich brown tones and a marble mantel above an electric fireplace at the after



Gymnasium

end of the room is surmounted by panes of plate glass mirror enclosed in metal frames.

Heavily upholstered, fixed settees and arm chairs finished in blue leather, together with individual and party tables are placed about the room for the comfort and convenience of its occupants. A counter for the sale of cigars, cigarettes, etc., is located at the forward starboard corner of the room.

B Deck

The *B* deck is given over chiefly to first class accommodations consisting of rooms with individual baths and de luxe suites.

There are four de luxe suites of particular elaborateness, two of which were occupied by President and Mrs. Wilson

(*Continued on page* 561)

Another Burden for Shipowners Proposed

Congress Considering the Revival of a Fee Basis to Make the Steamboat Inspection Service Self-Supporting

By Waldon Fawcett

FROM the very nature of things, the United States Department of Commerce must have intimate contact with the shipping and shipbuilding interests of the nation. Within this complex organization are many of the governmental institutions that deal constructively with maritime affairs—the Bureau of Navigation, the Steamboat Inspection Service, the Coast and Geodetic Survey, the Bureau of Fisheries and the Bureau of Lighthouses. Concentrated in this quarter also are institutions the activities of which indirectly, if not directly, have considerable influence upon American maritime progress. For example, there may be cited the Bureau of Foreign and Domestic Commerce and the Bureau of Standards, not forgetting the manufacturers' census of the Census Bureau.

That this executive organization which, as it stands, corresponds substantially to the departments of maritime affairs of foreign governments, should have entered in 1921 upon what promises to be its era of greatest usefulness is to be ascribed to the advent of Herbert Hoover as Secretary of Commerce. Mr. Hoover is not a practical shipping man. He is, however, a man of large affairs who, during a varied career, has been forced to take at all times the international outlook and whose deductions have been those of the trained and experienced engineer. More than that, Mr. Hoover had, during the world war and since, an intimate contact with the larger problems of oceanic transportation, handling and storage conditions at leading ports, etc., that afforded the most valuable prelude possible for his present responsibilities.

Inadequate Appropriations

With characteristic energy and by muster of unusual influence Secretary Hoover will probably accomplish in his new post that, the lack of which has been most largely responsible for the agitation for the conversion of the commerce department into a maritime department. Lack of adequate operating funds has been, as many shipping men doubtless realize, a serious impediment to the progress of the Department of Commerce for a number of years past. Certain branches of the Department were, to be sure, liberally provided for during the war, when their work was necessary for the success of military and naval operations. But the Commerce Department as a whole, and particularly the divisions devoted to maritime activities, has been so skimped in allowances that it has been with difficulty that routine work has been sustained, much less entry made upon the new projects that are essential to keep step with the progress of the period.

Just where the blame has rested may not readily be determined. Congress has been prone, obviously, to pare the appropriations for all governmental undertakings that have not the virtue of insistence. And the Department of Commerce has lacked a Moses to preach, on Capitol Hill, the gospel of the essentiality of its work. This is precisely what Secretary Hoover has set out to do. By personal appearance before the Appropriations Committees of Congress, by public addresses and by arousing the conscience of trade organizations and commercial bodies, the new Secretary of Commerce is endeavoring to induce the national legislature to provide funds that will enable his Department to supply something more than moral support to American shipping in the era of quickened international competition that impends.

Perhaps the most graphic illustration of the deficiencies of maritime service which Secretary Hoover has set out to correct is afforded by the radio situation. The enforcement of the wireless communications laws falls to the Bureau of Navigation but the funds provided for the task in recent years have been hopelessly insufficient. According to the frank confession of officials of the Navigation Bureau, the competent members of the personnel are leaving and the service is breaking down. During the past year 15 out of a total force of 27 have resigned. But the executives have faced the fact that, regardless of whether disaster happens from incomplete inspection, they could not exceed the money limitations set by Congress.

Radio Law Enforcement

The deplorable consequence of the short allowance, regarding which Secretary Hoover has entered protest, is that there are numerous requirements, and important requirements, in the wireless communications laws that the government does not even attempt to enforce. For instance, the Bureau of Navigation has practically abandoned the inspection of ship and shore stations for license. This leaves the Bureau practically without any information as to those stations, the wave lengths they are using, or the extent to which they may be interfering with the commercial wireless and with the receipt of distress messages from vessels at sea. There are about 3,000 ship stations and of that number 2,000 yet remain uninspected for license although the international convention specifically requires that every ship station shall be licensed by the nation to which the vessel belongs. Great Britain at present is beginning to inform American vessel masters that unless their stations are licensed they will be penalized when they enter British ports.

According to the information in the possession of the Bureau of Navigation at the close of May, 1921, about 50 percent of American vessels equipped with wireless are clearing without inspection. The Bureau officials are perturbed, feeling that the inspection of the instruments on these vessels is exceedingly important for the reason that the instruments are very delicate and are readily thrown out of adjustment, whereas the operators on board are not deemed to be, in most instances, competent to make repairs or adjustments. Within the expectations of the officials at Washington, the wireless men on the ships are operators, pure and simple, receiving and sending messages, but not radio engineers. Even if the ship man qualifies as a radio engineer, he has not at hand, presumably, the instruments with which to make adjustments.

Unable to Send Distress Signal

How serious for shipping interests this situation is and how well it has justified a personal appeal to Congress by Secretary Hoover was indicated only a short time ago when an inspector, on the staff of the Bureau of Navigation, found that the instruments on board a vessel, when adjusted to the 600-meter wave length on which distress calls are sent would not send out a distress signal—did not send a sound. This was but one of a number of similar instances. Equally

serious from the shipping standpoint is the fact that with the increasing use of the radio for point to point communication on land, systems are being created throughout the country that are resulting in a degree of interference with the ship stations—the lifesaving mediums of the ships.

Fee Basis for Inspection

The collapse of the government's wireless inspection service, because the expense of the system has grown out of the bounds of the $60,000 a year that has been allotted by Congress, has lately precipitated the question whether it might not be wise to make a charge to shipowners or operators for the inspection and license service, as is done by some other maritime countries. In answer to questions on the subject by leading Congressmen, Secretary Hoover has stated that he does not see any great objection to thus making the service partially or wholly self-supporting, similar to the United States patent system, etc. Great Britain makes a charge of 5 shillings for a ship station license and the same fee for a ship operator's license. Canada charges a $10 fee for a limited coast station or private commercial station and $1 for a ship station. In Spain the proprietor or licensee must pay all the expenses incurred by the official inspection by the government inspectors.

More significant to shipping men than this narrow proposal that the United States Government place its wireless inspection service on a fee basis is the broad proposition that is quietly receiving consideration in influential circles in Congress whereby the entire maritime inspection system would go back on a fee basis. The plan, should it be adopted, would be resorted to as a means of rendering prompt and efficient the supervisory and license services of the Department of Commerce without involving the Government in the additional expense which many of the legislators feel that it cannot sustain in the present state of the public finances.

Steamboat Inspection Service

This suggestion that the burden of expense involved in inspections be transferred from the shoulders of Uncle Sam to those of shipowners and operators was broached, even before the discussion over wireless inspections, in the course of deliberations at the Capitol with reference to the United States Steamboat Inspection Service—likewise a responsibility of the Department of Commerce. In conversation with a group of Congressional leaders, George Uhler, supervising inspector general, had stated that, beginning in 1922, a supplemental appropriation of $25,000 a year would be needed to cover the increase in the volume of inspection work, due to the expansion of the merchant marine and other causes. Thereupon, Congressman Joseph G. Cannon asked the head of the Steamboat-Inspection Service whether the laws could not be amended in such a way that the expense would be placed upon the vessel owners who presumably benefit by the inspection.

General Uhler stated that this could, of course, be done, if Congress was so minded, and he intimated that he thought it would be an excellent plan and entirely equitable and consistent, since, as he expressed it, "Great Britain charges for their surveys and charges for their commissions, or licenses as they call them, to officers." The increase in the traveling expenses of United States inspectors, coming on top of sharp increases in the rentals of offices at various ports occupied by the inspection service, has brought an addition in overhead which may reasonably be expected to continue for some time and which must be met by some other means than recurring "deficiency" appropriations by Congress.

The feeling in Congress is that if the fee system is invoked for services to vessels, all governmental services in the category should go on a pay basis, since it would not be equitable to single out the wireless or the steamboat inspection service for toll taking and allow other activities to be conducted wholly at government expense. The discussion has also brought out the fact that it is the general policy of maritime nations to impose fees for services rendered, such as the measurement of tonnage of ships, issue of registers, approval of crew lists and, as has been pointed out, for licenses for wireless ship stations and operators. These various fees take, in the administration of various maritime powers, the form of a stamp tax.

Fees Formerly Collected

While the circumstance has, doubtless, escaped the memory of many shipping men, the fact remains that the United States, for many years following the inauguration of its principal shipping inspection services, followed the conventional plan of collecting fees proportionate to the services rendered. However, in the year 1886 the Congress of the United States, by a rather radical action, abolished practically all the fees that had up to that time been exacted for services to American ships. At that time, the revenues of this country exceeded its expenses and Congress was concerned over the possibility of a surplus rather than a deficit in the Treasury. Indeed, the fee system in the case of the Steamboat Inspection Service, instead of merely meeting expenses or making the service self-sustaining,had piled up a surplus of $600,000 to $700,000 to the credit of the Steamboat Inspection Service, even as the United States Patent Office has a heavy surplus to its credit in the United States Treasury, thanks to the collection of fees from inventors and registrants of trademarks.

That many shipping men will resent the imposition of fees may be expected, the more surely, when it is recalled that when the fee system was abolished in 1886 a number of vessel owners felt so deeply on the subject that, not content to be relieved of further charges of that kind, they sought to recover from the government the fees or license charges that had been paid during the years before the law was repealed. The financial managers of Congress at that time would not hear of the return of any fees, declaring that such a precedent would open the way for claims against every surplus in the national treasury. But some of the shipping men were never satisfied that they were not discriminated against in favor of competitors who came into the business after the fee system went to the discard.

Self-Supporting Basis

The general proposal to put all United States maritime inspection services back on a fee basis is induced, of course, by the fact that the government is now staggering under a heavy burden of debt and seeks to reduce its fixed charges instead of increasing them. Asked specifically as to Steamboat Inspection Service by interested Congressmen, Secretary of Commerce Hoover said: "I think there is a good deal to be said regarding putting this service back on a fee basis. It does seem to me that when a special service is given one particular industry like this, the service ought to carry its own expense. If Congress wishes to give financial assistance to that industry, it should be given directly and not indirectly."

Secretary Hoover and his subordinates have told Congressional committees that the maritime inspection services can be put on a self-supporting basis without much difficulty, but it is admitted that careful calculation would be needed to fix the proper schedules of fees. For Secretary Hoover feels that the fees should be gaged merely to meet expenses and not to return any profit to the Government as was done

(*Concluded on page* 560)

U. S. S. Tennessee at Full Speed on Her Trials Off Rockland, Me., May 16

Battleship Tennessee Successfully Completes her Final Trials

THE United States battleship *Tennessee*, the latest electrically-propelled superdreadnought, was given her final trials off Rockland during the latter part of May and among the results the following are of special interest:

Her actual steam consumptions at various speeds were better than the Westinghouse Company's guarantees by from five to ten percent.

The maximum speed developed was 21.378 knots.

She was brought to rest from top speed in less than three minutes. This is believed to be a record for so large a ship and is about the severest test that can be imposed upon her machinery, as the propellers were being operated astern while the ship was forging ahead.

The salvo test, i. e., the firing of all twelve 14-inch guns at once, caused no injury to her electrical equipment.

With astern operation of her propellers she developed 15 knots.

Her turning circle with all propellers operating forward and rudder hard-over is about 700 yards, which is hardly more than that of a destroyer.

The propelling machinery of the *Tennessee* consists of two 15,000-KVA Westinghouse turbo-generators and four 8,375 horsepower Westinghouse propeller motors. Her length is 625 feet, beam 91 feet and displacement 33,000 tons.

9,420-Ton Tankers San Lamberto and San Leon

THE following description, drawings and details of these vessels should be of special interest on account of the completeness of the data furnished. It is the practice of MARINE ENGINEERING to present data of modern vessels of various types in such form as to make it suitable for ready reference.

The *San Lamberto* and *San Leon* are vessels of the shelter deck type constructed on the Isherwood system of longitudinal framing and classed 100A-1 Lloyd's. They also comply with the requirements of the Panama and Suez Canal authorities and the rules and regulations of the United States Steamboat Inspection Service and also the regulations of the British Board of Trade.

The vessels were built by the George A. Fuller Company at their shipyard in Wilmington, N. C., a feature of the work being the speed in construction accomplished, the contract being signed August 31, 1920, and the vessels delivered February 19 and March 29, 1921, respectively.

The *San Lamberto* and *San Leon* are equipped with the White System fuel oil burning installation, Reilly evaporator and feed water heater, Schutte & Koerting injector and Hall refrigerating machine.

Lito-silo decking is provided throughout the living spaces except in toilets, bath rooms and galley, where tile or cement is used.

These vessels completed the outstanding contracts of the Fuller Company and upon their delivery the yard was closed. The surplus material and plant of the Wilmington yard will be offered for sale and another of the large companies, which responded to the call of the Government to help meet the demand for ships in the war emergency, will retire from shipbuilding.

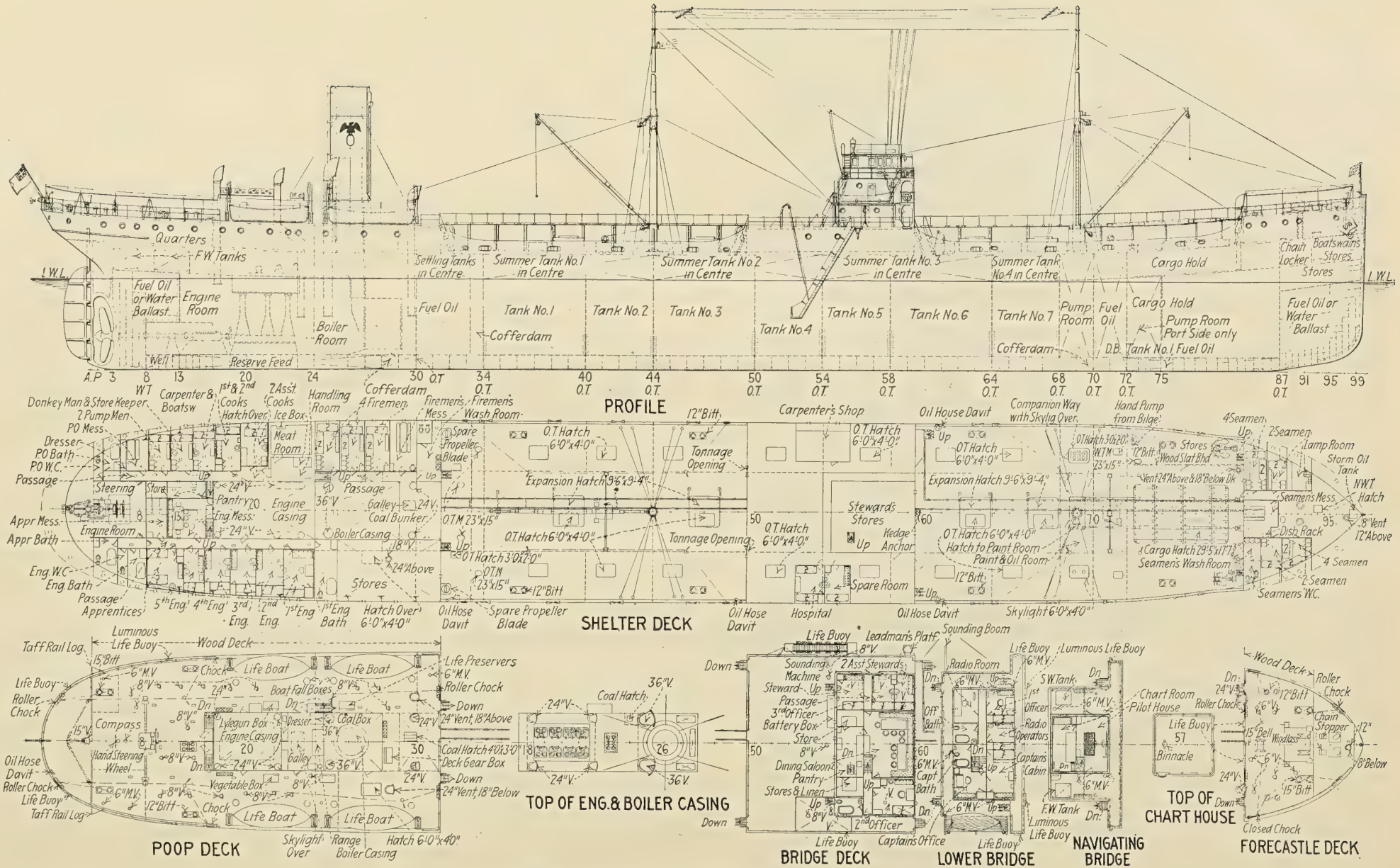


Fig. 1.—9,420 Deadweight Ton Tanker: Profile and Deck Plans

9,420-Ton Tankers San Lamberto and San Leon

General Information

Service: Bulk Petroleum Tanker.
Builder: George A. Fuller Co., Wilmington, N. C.
Owner: Eagle Oil Transport Co., Ltd., London, England.

Characteristics

Length, overall	411′ 9″
Length, B. P.	395′ 6″
Breadth, molded	55′ 0″
Depth, molded, to shelter deck	34′ 11″
Draft, loaded	27′ 4¼″
Draft, light	9′ 3″
Block coefficient	0.78
Midship section coefficient	0.978
Longitudinal coefficient	0.873
Speed. loaded, knots, designed	10.5
Cruising radius, nautical miles	
Framing	Longitudinal
Class	Lloyd's 100 A-1

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull	3,411
**Weight Propelling Machinery	510
Deadweight Capacity	9,420
Displacement	13,341

(In tons of 100 cubic feet)

Gross register	6,349
Net register	3,808

* Weight of Hull includes Hull Proper, Hull Fittings, Equipment and Outfit.

** Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez	6,671	4,674
Panama	6,740	6,019

Equipment

2 Bower Anchors, stockless, each,	63¾ cwts.
1 " " " "	54½ "
1 Stream " ex.-stock, "	17½ "
1 Kedge " " "	7½ "
Cable, 2¼″, stud chain	270 fms.
Streamline, 4¼″ steel wire	90 "
Towline, 4½″ steel wire	120 "
Hawsers, 2, 8″ Manila, each	90 "
Warps, 2, 8″ Manila, each	90 "

Rudder

Area	169 sq. ft.
Dia. Stock	11″
C. Press. abaft. C. L. pintles	3′ 8½″

Complement

Deck officers and wireless operators	6
Deck crew	10
Engineer officers	5
Engineer crew	13
Furser's and steward's department	15
Total officers and crew	49
First-class passengers	None
Second-class passengers	None
Third-class passengers	None
Total passengers	
Total complement	49

Handling Equipment

	No.	Type	Capacity	Length
Masts	2	steel	....	....
Derrick posts	....	....	....	....
Booms	3	steel	5 ton	....
Discharging Capacity				

Deck Machinery

Steering Gear	right and left screw
Type	double 9″ x 9″ engine
Windlass	steam, double 9″ x 9″ engine
Capstans	
Winches	(1) 9″ x 9″ double geared (2) 8¼ x 8 single geared

Life Saving Equipment

	No.	Type	Length
Lifeboats	2	metallic	24′-0″
"	2	"	26′-0″

Propelling Machinery

Boilers

Number	3
Type	single ended Scotch
Length	11′-3″
Diameter	15′-3″
Furnaces	9
Fuel	oil
Draft	forced (closed ash pit)
Total heating surface, square feet	9411
Total grate surface or furnace volume	210 sq. ft.
Superheat, degrees F	
Working pressure, lbs. per sq. in.	200
Normal fuel consumption:	
Per day, tons	
Per horsepower hour, pounds	
Normal steam production:	
Per hour per pound of fuel	lbs.
Total per hour	lbs.

Engines

Number	1
Type	triple expansion reciprocating
Size	24½″ x 41½″ x 72″ x 48″ stroke
Horsepower, designed	2,800

Propellers

Number	1
Type	built up, 4 bladed
Weight	
Diameter	17′-0″
Pitch	15′-9″
R. P. M.	80
Projected area, sq. ft.	76.73
Developed area, sq. ft.	88.30

Auxiliary Machinery

Machinery Space

Condensers, main,	3,500 sq. ft. cooling surface
aux.,	600 sq. ft. cooling surface
Evaporators	(1) capacity, 25 tons per day
Distiller	
Filter	capacity 600 gallons
Feed water heater	45,000 lbs. per hour
Injector (1)	
Forced draft fan	75″ (2) 7 x 5 engines

Pumps

Main circulating	centrifugal 14″
Feed	(2) vert. simplex 12 x 8 x 18
Ballast	(1) horiz. duplex 12 x 10¾ x 12
Sanitary	(1) 6 x 5¾ x 6
Fresh Water	(1) 6 x 5¾ x 6
Fuel oil transfer	(1) 7½ x 6 x 10
Aux. air and circulating	10 x 12 x 12 x 12
†Air	26 x 21
†Bilge	(2) 5 x 21
†Evaporator feed	1¾ x 8
Cargo oil pumps	(2) 18 x 14 x 24
Fuel oil service	(2) 6 x 4 x6
Donkey and fire	(1) 12 x 10¼ x 12

† Worked from a walking beam on the low-pressure cylinder.

Refrigerating Machinery

1 Unit—Hall's	CO_2—2-ton

Electric Equipment

Generators	(2) 15 K.W.—100 volts—D.C.
Radio	Marconi
Emergency	

Holds

No.	Length	Hatches
1	47′-3″	29′-5″ x 17′-7¾″

Capacities

Cargo Space

Compartment	Cu. ft.	Bbls.	Tons*
No. 1 main tank, P. & S.	53,794	9,581	1,345
" 2 " " "	35,910	6,395	898
" 3 " " "	53,794	9,581	1,345
" 4 " " "	35,910	6,395	898
" 5 " " "	35,910	6,395	898
" 6 " " "	53,794	9,581	1,345
" 7 " " "	37,896	6,749	947
" 1 summer tank	11,455	2,040	286
" 2 " "	11,455	2,040	286
" 3 " "	11,455	2,040	286
" 4 " "	4,764	848	119
Totals	346,137	61,645	8,653

	Cu. Ft. Bulk	Cu. Ft. Bales
For'd cargo hold	60,990	56,100

* 40 cu. ft. per ton.

Refrigerated Space

Compartment	Cu. Ft.
Provision room	550

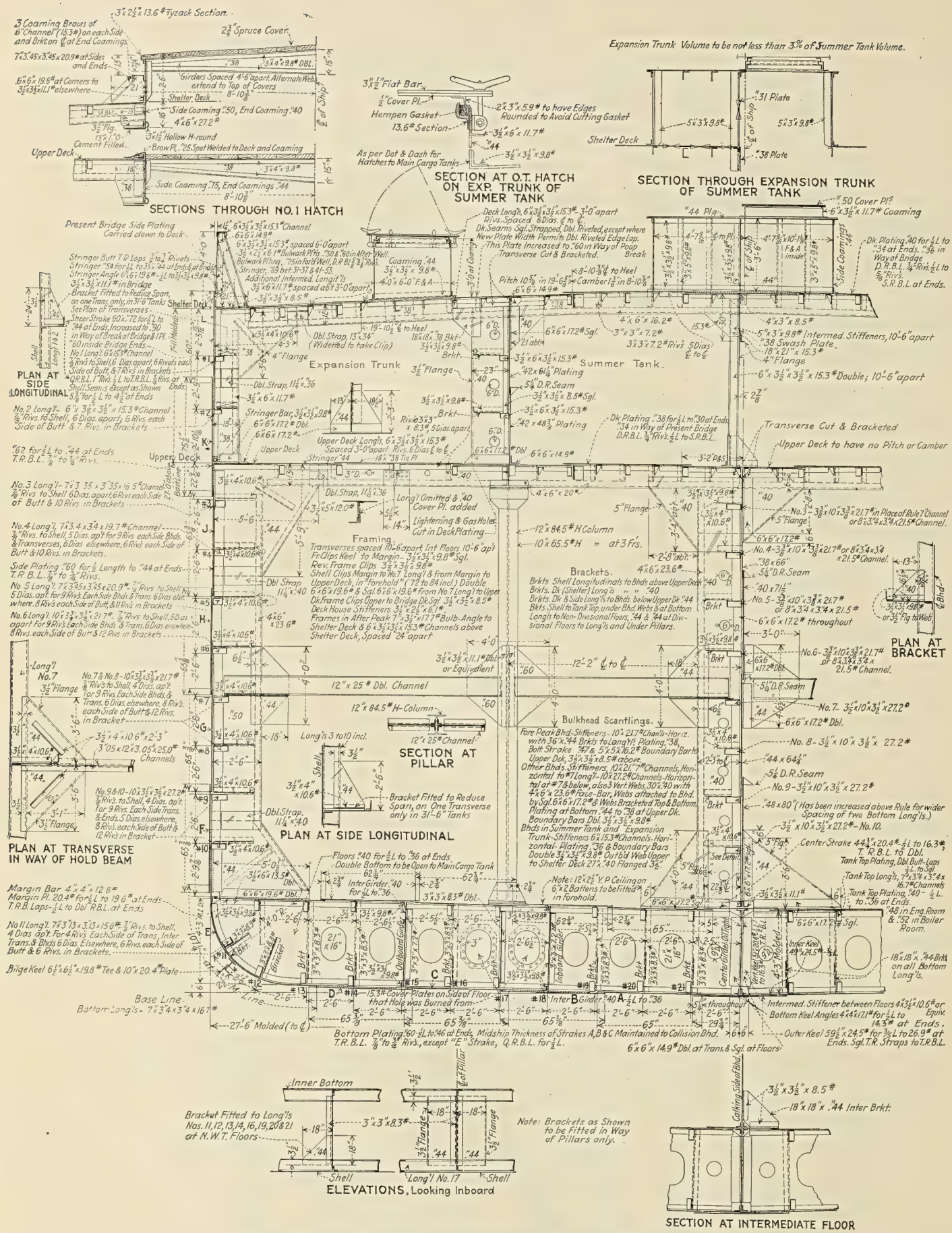
Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons
Aft. P. & S.	28,392	5,056	747
Forward, P. & S.	19,824	3,531	522
Double bottom for'd, P. & S.	3,690	657	97
Settling tanks	3,654	651	96
Fore. peak	6,776	1,207	178
Totals	62,336	11,102	1,640

*38 cu. ft. per ton; 42 gals. per bbl.

Tanks

Compartment	Cu. Ft.	Tons F.W.	Tons S.W.
Fore peak	6,776	194	199
Aft peak	4,977	138	142
Double bottom, forward	3,690	102	105
Total	15,443	434	446


SECTIONS THROUGH NO.1 HATCH
SECTION AT O.T. HATCH ON EXP. TRUNK OF SUMMER TANK
SECTION THROUGH EXPANSION TRUNK OF SUMMER TANK
PLAN AT SIDE LONGITUDINAL
PLAN AT TRANSVERSE IN WAY OF HOLD BEAM
PLAN AT SIDE LONGITUDINAL
SECTION AT PILLAR
PLAN AT BRACKET
ELEVATIONS, Looking Inboard
SECTION AT INTERMEDIATE FLOOR
Framing.
Brackets.
Bulkhead Scantlings.
Summer Tank.
Expansion Trunk
Transverse Cut & Bracketed
Upper Deck to have no Pitch or Camber
Expansion Trunk Volume to be not less than 3% of Summer Tank Volume.
Bottom Plating 60'-½L to 46 at Ends, Midship Thickness of Strakes A, B & C Maintained to Collision Bhd.
Fig. 2.—9,420 Deadweight Ton Tanker: Midship Section

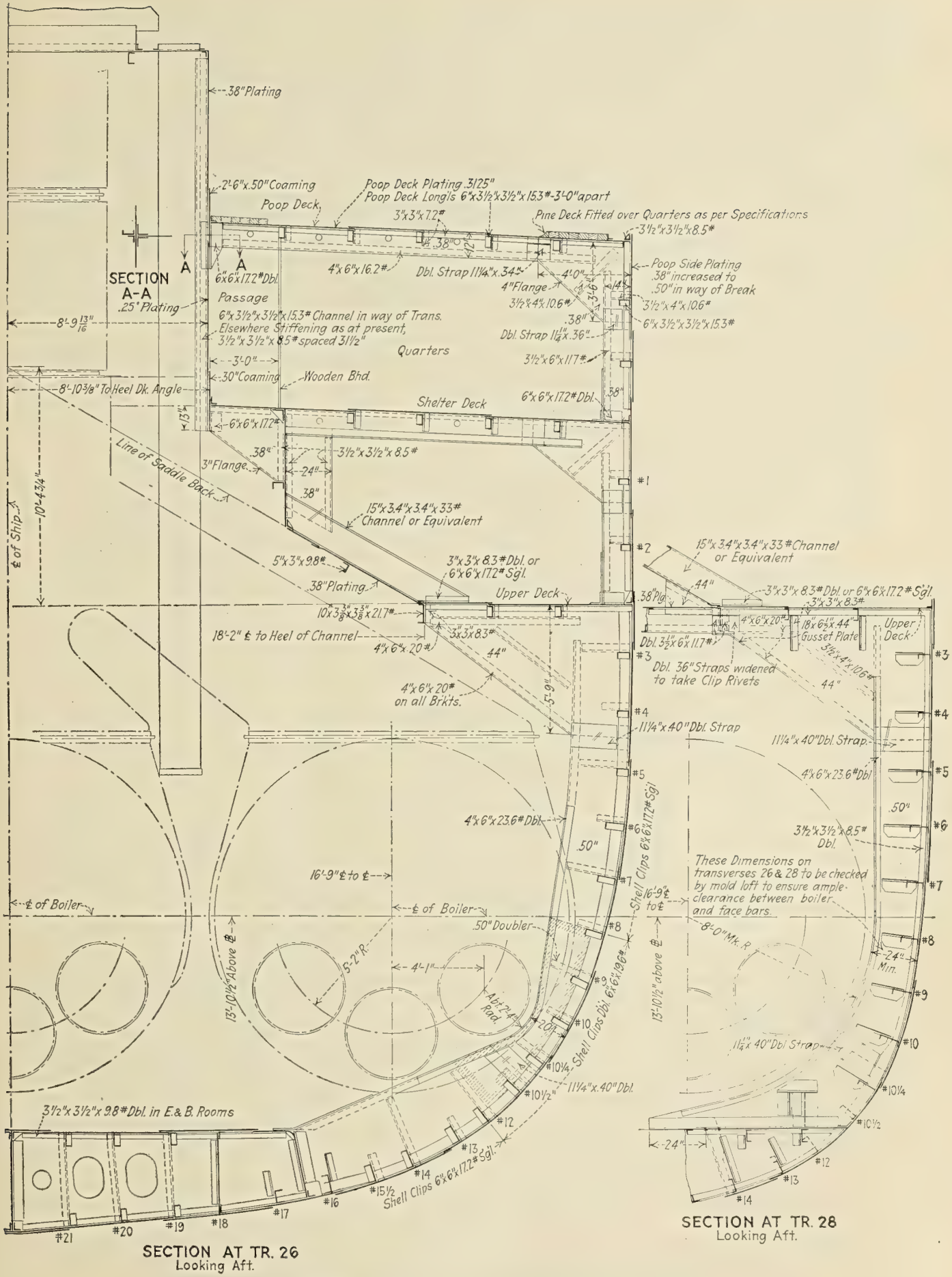
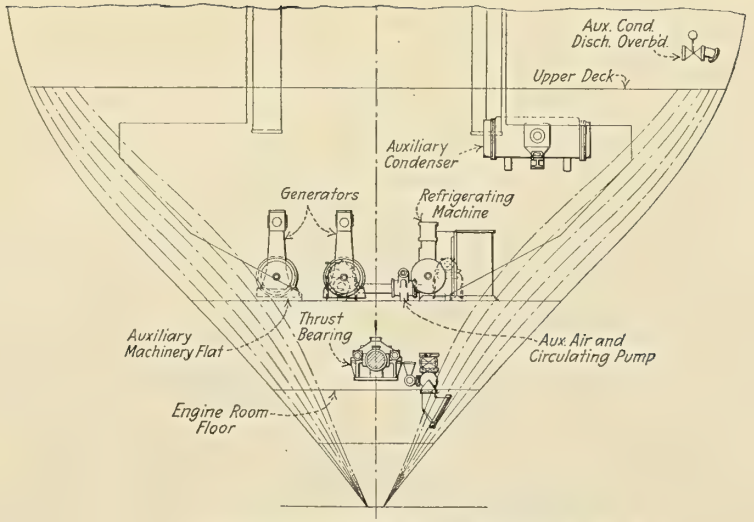
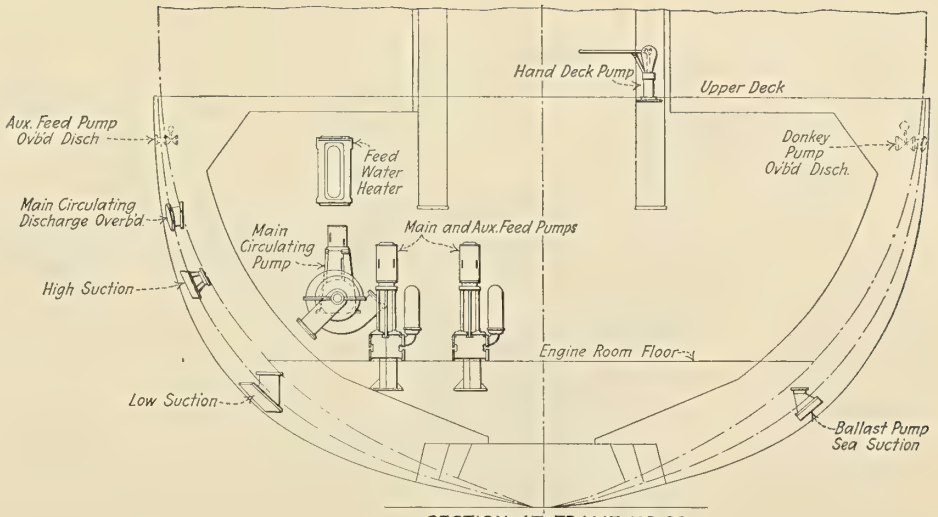


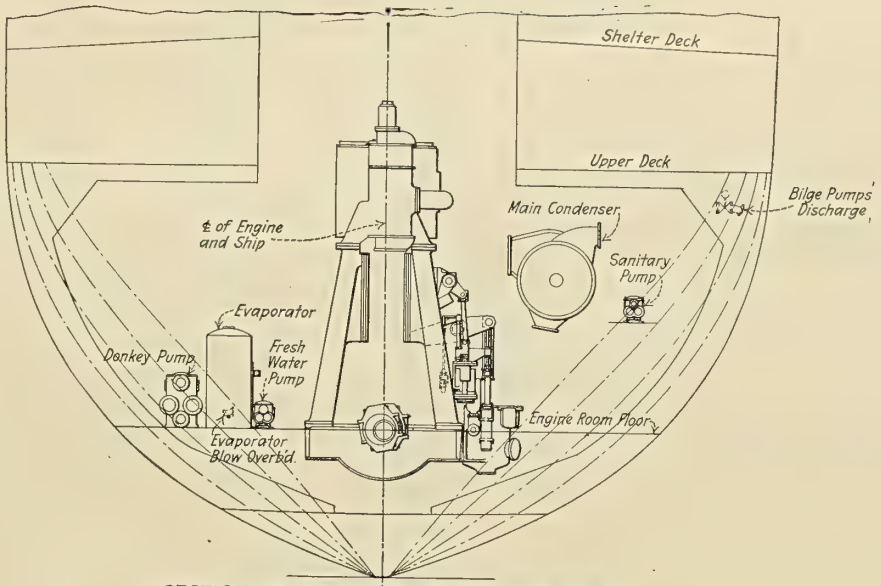
Fig. 3.—9,420 Deadweight Ton Tanker: Framing Details in Way of Boiler Space



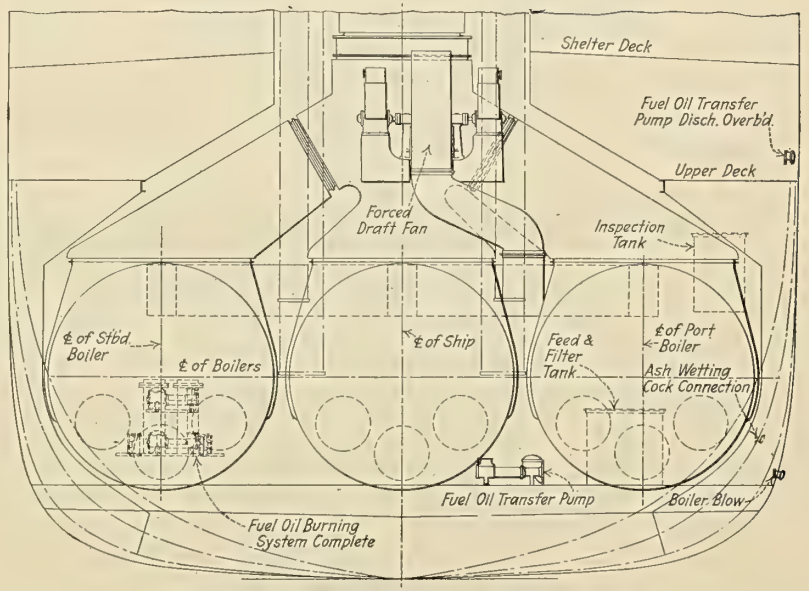
SECTION OF ENGINE ROOM AT FRAME NO. 18
Looking Aft. to Bhd. No. 13



SECTION AT FRAME NO. 22
Looking Ford to Bhd. No. 24



SECTION OF ENGINE ROOM AT FRAME NO. 22
Looking Aft to Frame No. 18



SECTION OF FIRE ROOM AT FRAME NO. 29
Looking Aft to Bhd. No. 24

Fig. 4.—9,420 Deadweight Ton Tanker: Machinery Arrangement, Sections

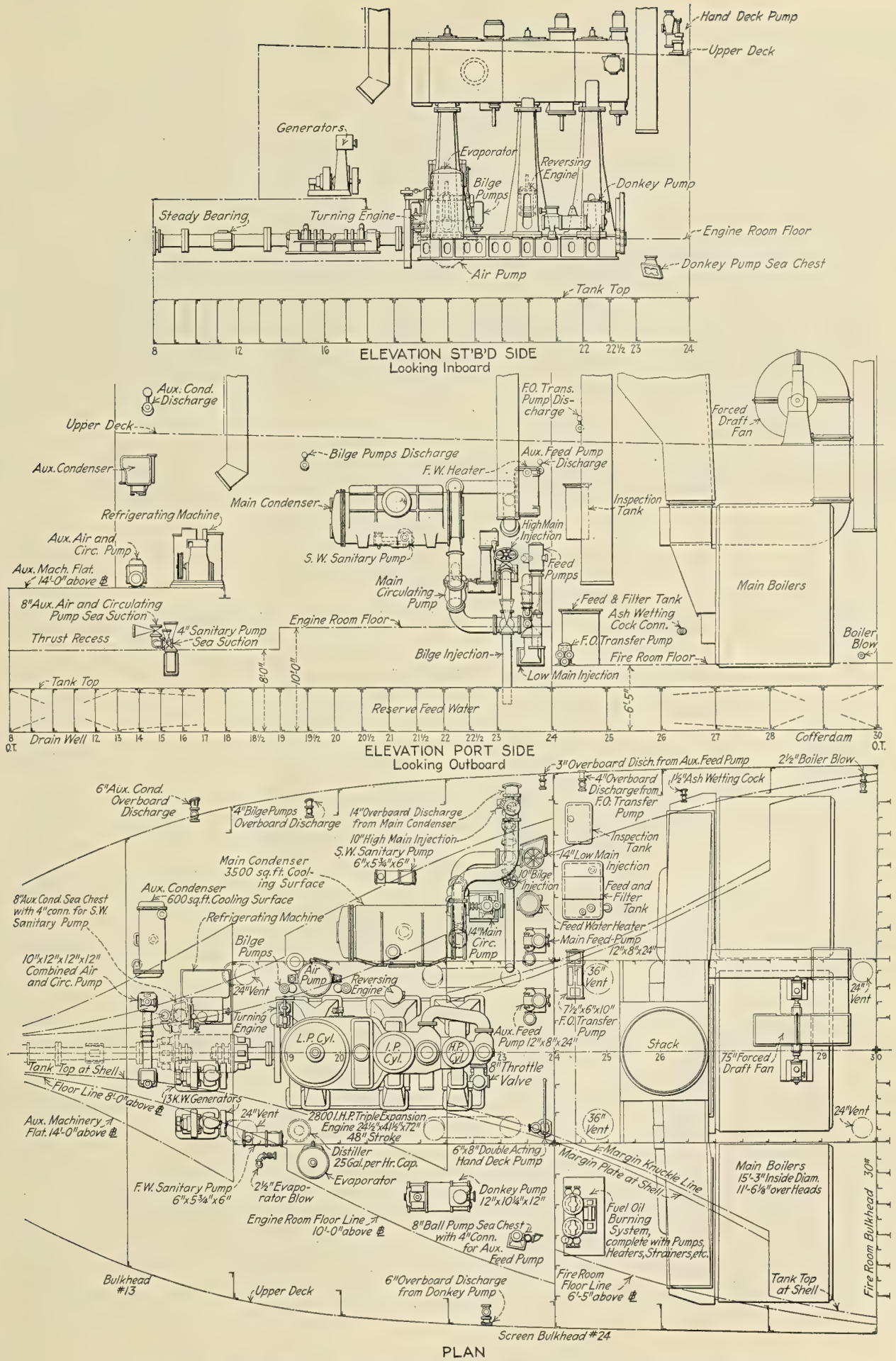


Fig. 5.—9,420 Deadweight Ton Tanker: Machinery Arrangement, Plan and Elevation

S. S. Minnekahda, 17,200-Ton One-Class Liner

The Minnekahda, A Ship of Democracy

One-Class Liner Built in Ireland, Reconditioned in the United States and Placed in American Service to Germany

POSSIBLY one of the most striking examples of tonnage adaptation in the development of shipping since the war is to be found in the *Minnekahda,* operated by the International Mercantile Marine Company under the colors of the American Line, and at present in service between New York and Hamburg, carrying third class passengers only.

This ship has been very widely advertised as a third class liner, and has caught the fancy of the thrifty travelers in that class through her status of a "ship of democracy," in which there can be no distinction between classes of passengers carried, since she carries but one.

It is in the ship's adaptation to her present use, however, that the average shipping man, designer, engineer or constructor will find the greatest material for study. The *Minnekahda* was constructed for a different line of business than the one she is now in, under a different flag, and in different structural form.

British Built

Built in a British yard, for the Atlantic Transport Company, the ship was designed to take her place in the famous "Minne" class of that company's line, operating between New York and London. The vessels of that class were large combination freight and passenger carriers, with accommodation for cabin business only. As such they were exceedingly popular before the war.

While the *Minnekahda* was taking shape at the Harland & Wolff yards at Belfast, the four "Minne" ships were sent to the bottom one after another by German submarines—the *Minneapolis, Minnetonka, Minnewaska* and *Minnehaha.* Before the new ship was ready for launching, the Allies were straining every nerve to secure adequate transport tonnage. Therefore the *Minnekahda* was rushed overboard in 1917 without her passenger-deck houses or fittings, and equipped as a transport. Her large carrying capacity in both supplies and troops made her specially valuable. Her war service was notable, and she served through the busy post-war years of 1919 and 1920 with profit to her owners.

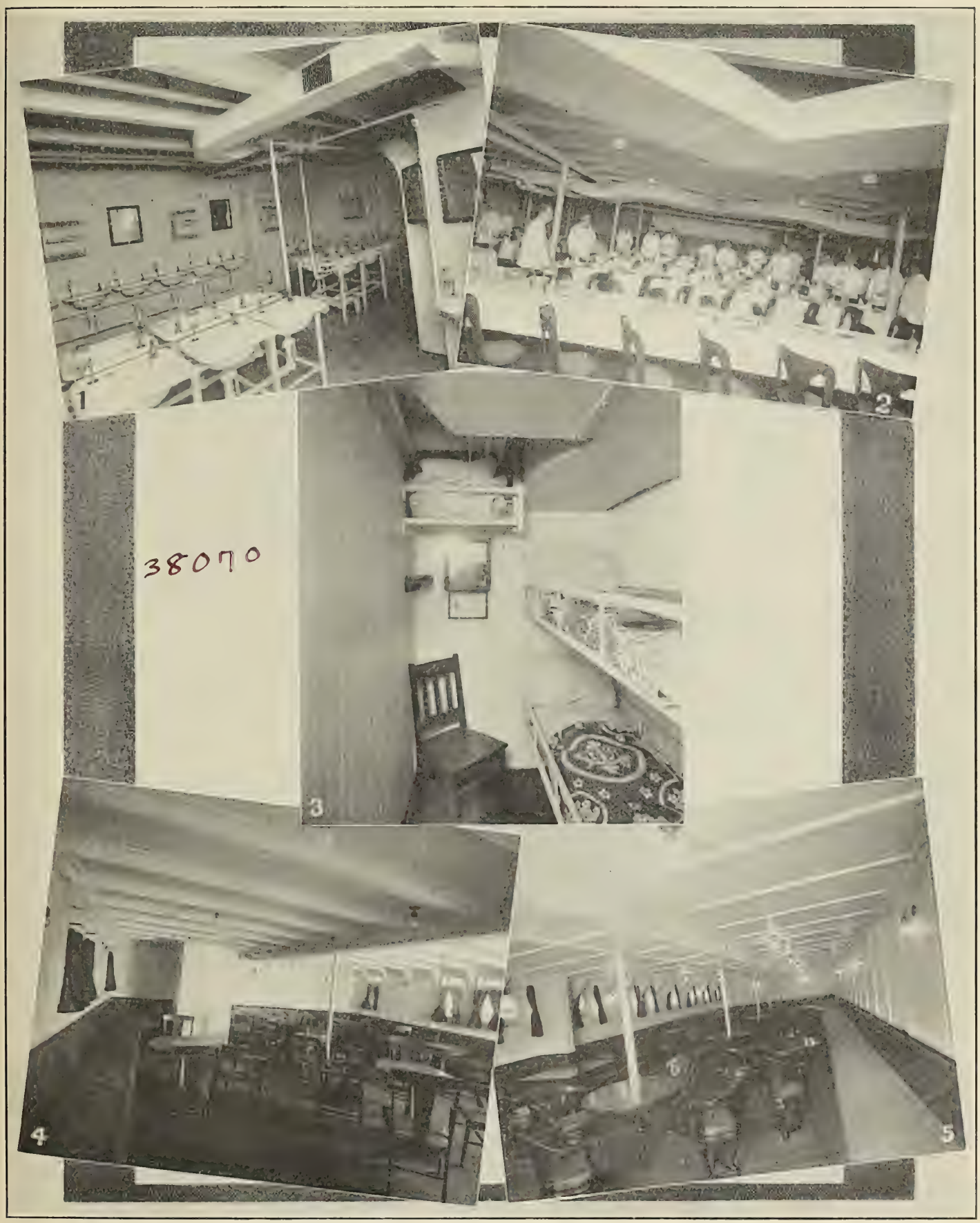
Transferred to American Flag

In the fall of 1920 the International Mercantile Marine, the American company owning the Atlantic Transport Company, decided that in view of changed conditions, the time was not ripe to revive its London passenger trade, and devised other uses for the *Minnekahda,* in the new American Line service to Germany. In order to place her in this service, it was necessary to transfer her to the American flag. The British Government is not keen on allowing ships to be transferred from its registry, but arrangements for this transfer were agreed to by the Board of Trade, and on November 3, 1920, the British ensign was hauled down on the *Minnekahda* at New York, and the Stars and Stripes were raised on her ensign staff by P. A. S. Franklin, president of the International Mercantile Marine Company. The ship is the largest ever transferred from British to American registry.

Reconditioned in American Yard

The ship was then taken in hand for adaptation to her new uses. A contract was made with the Bethlehem Ship Building Corporation to do the work at its Fore River plant, Quincy, Mass., and the ship was sent there the second week in November. The job was scheduled for completion in March. Working from plans prepared under the direction of William F. Gibbs, chief constructor for the International Mercantile Marine Company, the Fore River plant had the vessel ready for delivery several days ahead of the agreed

INTERIOR VIEWS OF THE AMERICAN LINER MINNEKAHDA



S. S. Minnekahda: (1) Lavatory, (2) Dining Saloon, (3) Two-Berth Stateroom, (4) Smoking Room, (5) Lounge.

date. The ship left the yard, complete in every detail, on March 15, and after docking proceeded to New York to load for her first voyage. The job on her had been a big one, calling for an expenditure of about $700,000, and the creditable manner in which it was done in an American yard was a source of gratification to all concerned. In a statement made at the time the ship was delivered, Mr. Gibbs had this to say about the job:

"The work of completing this ship to carry passengers might have been done abroad, before her transfer to American registry. The company chose to have it done here. The workmanship and materials in the job are as good as can be found anywhere in the world. The completion of the work reflects the greatest credit on the yard, as the installation of the passenger fittings embodies the latest ideas in equipment and quality."

As completed, the *Minnekahda* is without the upper deck originally designed for her, which gives her a rather rakish appearance, since her deck heights are less than are usually found on a vessel of her length, 640 feet. Her beam is 66.4 feet. The ship has ample space for 2,150 passengers, with adequate deck space for open air exercise.

Arranged Like First Class Liner

In equipment the *Minnekahda* is not unlike a first class liner, with public rooms, including a dining room seating four hundred, a large lounge and two smoking rooms. She has a number of two-berth, four-berth and six-berth sleeping rooms, all neatly equipped, and dormitory spaces for single men and single women, partitioned off with canvas. The walls of the sleeping quarters are done throughout in white enamel. The floors have sanitary coverings. There is a complete and satisfactory ventilating system, and her plumbing equipment is of the best.

The *Minnekahda* has triple screws. Her power plant consists of two triple expansion reciprocating engines exhausting into a low pressure turbine on the center shaft. Steam is supplied by Scotch boilers.

Handy Steam Velocity and Steam Flow Tables*

By V. F. Davis

ENGINEERS and others who make a practice of designing pipe to carry steam at any velocity from 2,000 to 12,000 feet per minute will appreciate the tables accompanying this article. Table 1 gives the capacities of steam pipes varying in diameter from ¾ inch to 15 inches, steam pressures varying from 1 pound to 250 pounds per square inch. The steam velocity in every case is exactly 6,000 feet per minute. For other velocities the factors given in Table 2 are applied to Table 1.

Example: How many pounds of steam per minute will a 2-inch pipe line carry at a velocity of 7,000 feet per minute, the steam pressure being 200 pounds per square inch gage?

Answer: In Table 1, opposite 200 pounds pressure and under 2-inch pipe, we find 65.32 as the weight of steam that would be carried by a 2-inch pipe at 6,000 feet per minute.

To find the velocity of steam flow in feet per minute for a given pipe size and flow of steam in pounds per minute at any given pressure, multiply the weight of steam in pounds by the cubic feet in one pound of steam at the given pressure and divide by the area of the pipe in square feet, or

$$\text{Velocity in feet per minute} = \frac{w \times D_1}{A},$$

Where w = weight of steam in pounds flowing through the pipe (see Table 1).

D_1 = cubic feet in one pound of steam at the given pressure (see Table 1).

A = area of the pipe in square feet (see areas just below pipe sizes in Table 1).

TABLE 1.—CAPACITIES OF STEAM PIPES IN POUNDS PER MINUTE WITH A STEAM FLOW VELOCITY OF 6,000 FEET PER MINUTE

Steam Pressure in Lbs. Per Sq. Inch Gage	Weight of Steam Per Cu. Ft. in Pounds	Cu. ft. in (1) Lb. of Steam = D_1	Diameter of pipe in inches = d_1 Area of pipe in square feet = A_1 ¾" 0.0037	1" 0.0060	1¼" 0.0104	1½" 0.0141	2" 0.0233	2½" 0.0332	3" 0.0513	4" 0.0884	5" 0.1389	6" 0.2066	8" 0.3474	10" 0.5476	12" 0.7854	15" 1.268	Steam Pressure in Lbs. Per Sq. Inch Gage
			Weight of Steam in Pounds Per Minute = $A_1 \times 6000 \div D_1$														
1	.0396	25.23	.879	1.426	2.473	3.394	5.541	7.586	12.19	21.02	33.03	47.70	81.82	130.2	186.7	301.5	1
5	.0490	20.38	1.089	1.766	3.061	4.151	6.859	9.774	15.10	26.02	40.89	54.14	101.2	161.1	231.2	373.3	5
10	.0606	16.49	1.346	2.183	3.784	5.130	8.477	12.08	18.60	32.16	50.52	72.98	125.1	198.5	285.7	461.3	10
20	.0834	11.99	2.018	3.002	5.204	7.055	11.65	16.61	25.67	44.23	69.50	100.3	172.1	274.0	393.0	634.5	20
30	.1058	9.45	2.349	3.809	6.603	8.941	14.79	21.07	32.57	56.12	88.19	127.3	218.3	347.6	498.7	805.0	30
40	.1278	7.82	2.813	4.603	7.979	10.81	17.87	25.47	39.36	67.82	105.9	153.9	263.9	420.1	602.6	972.8	40
50	.1497	6.68	3.323	5.389	9.341	12.66	20.92	29.82	46.07	79.40	124.7	180.1	309.0	491.8	705.4	1138.	50
60	.1715	5.83	3.807	6.174	10.70	14.51	23.97	34.16	52.83	90.97	142.9	206.4	354.0	563.5	808.3	1305.	60
70	.1930	5.18	4.285	6.949	12.11	16.33	26.98	38.45	59.42	102.3	160.8	232.3	398.5	634.0	909.7	1468.	70
80	.2141	4.67	4.753	7.708	13.36	18.11	29.93	42.65	65.91	113.5	178.4	257.7	442.0	703.5	1009.	1627.	80
90	.2358	4.24	5.235	8.490	14.71	19.95	32.97	46.97	72.59	125.0	196.4	283.8	486.8	774.9	1111.	1794.	90
100	.2570	3.89	5.706	9.254	16.04	21.74	35.93	48.63	79.12	136.3	214.2	335.1	530.6	844.6	1211.	1955.	100
120	.3003	3.33	6.666	10.81	18.73	25.40	41.98	59.81	92.43	159.2	250.2	361.4	619.9	986.6	1414.	2284.	120
150	.3636	2.75	8.072	13.09	22.69	30.76	50.83	72.43	111.9	192.8	303.0	437.6	750.6	1194.	1713.	2766.	150
200	.4672	2.14	10.37	16.82	29.15	39.53	65.32	93.08	143.8	247.8	389.4	562.4	964.6	1534.	2201.	3555.	200
250	.5714	1.75	12.68	20.57	35.65	42.62	79.82	113.8	175.8	303.0	419.0	687.7	1179.	1877.	2692.	4347.	250

Areas of pipe are actual areas of standard pipe.

For 7,000 feet per minute Table 2 gives the factor of 1.166, or, 65.32 x 1.166 = 76.2 pounds per minute.

Table 1 is also very convenient for computing steam velocities through any ordinary pipe under pressures up to 250 pounds per square inch.

TABLE 2.—FACTORS TO BE APPLIED TO TABLE 1 TO FIND THE CAPACITY OF PIPE AT OTHER VELOCITIES

	Velocity in Feet Per Minute									
Velocity..	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	12,000
Factor ..	0.333	0.500	0.666	0.833	1.000	1.166	1.333	1.500	1.666	2.000

Example: What is the velocity of steam in feet per minute through a 4-inch pipe delivering 104 pounds of steam per minute at 100 pounds gage pressure per square inch?

Answer: From Table 1 we find the cubic feet in one pound of steam at 100 pounds pressure = 3.89. Then the steam flow in cubic feet per minute = 104 x 3.89 = 404.5 Now from Table 1 we also find the area of a 4-inch pipe in square feet = .0884. Hence, the velocity of steam flow = 404.5 ÷ .0884 = 4,573 feet per minute.

With the data given in these tables either the quantity or velocity of steam delivered by various sizes of pipes can be determined quickly, the other factors being known.

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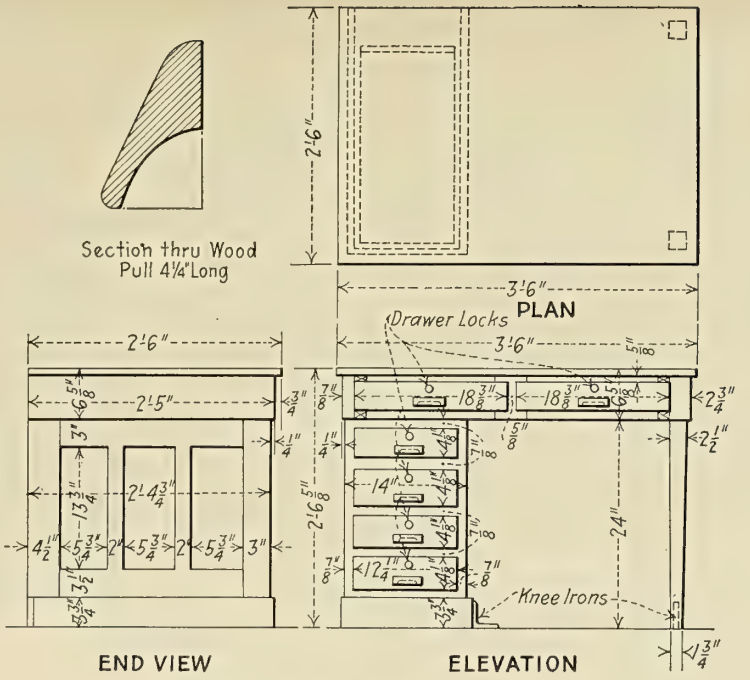
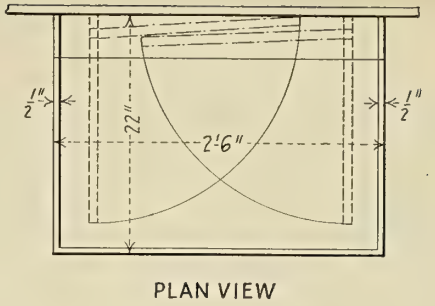
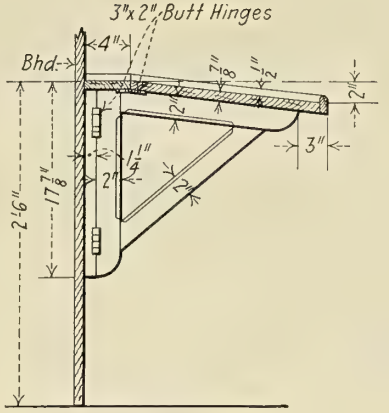
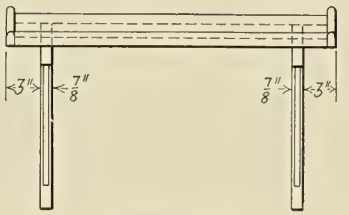


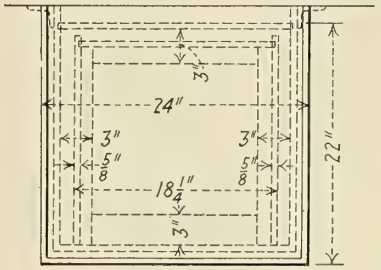
FLAT TOP DESK



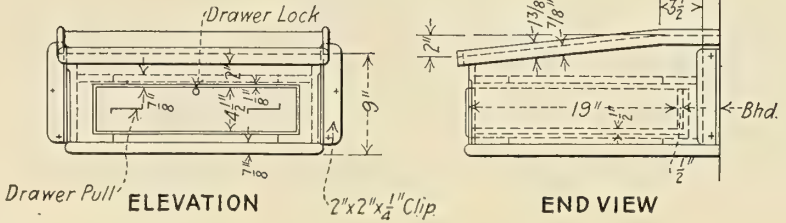
DROP LEAF TABLE

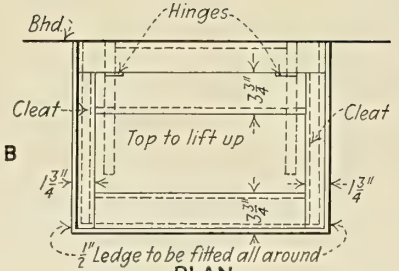






BULKHEAD DESK-TYPE A





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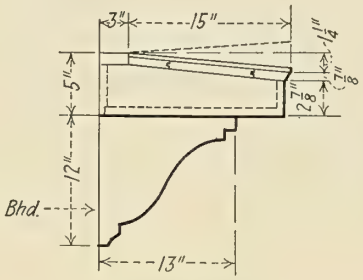

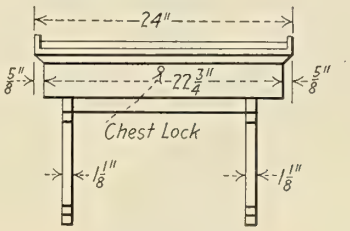

Non-Ferrous Metals and Compositions

By Horace Holden Thayer*

This is the second of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the various classes of workers who have to deal with these materials from the materials point of view.

IRON and steel have been dealt with in the May issue of MARINE ENGINEERING, and it is the purpose of this paper to deal with the other metals that are used in ship construction as well as with some of the more useful compositions that are made with them.

ALUMINUM

Aluminum is a soft, ductile, malleable metal of grey white color. Its chief distinguishing characteristic is its extreme lightness. It is very non-corrosive and has a tensile strength close to that of copper. It melts at about 1,300 degree F.

Although this metal is used very little in ship construction, a copper and aluminum alloy called aluminum bronze is one of the best bronzes yet produced, but it is difficult to handle in the foundry. A little aluminum in brass alloys improves the casting qualities but increases the shrinkage.

ANTIMONY

Antimony is a brittle metal of bluish white color with the least tensile strength of any of the metals that are useful to the shipbuilder. It expands while solidifying from fusion, like iron. It melts at something over 800 degrees F.

Its chief use is in the making of alloys, including bearing metals. Its effect on bearing metals is to increase their hardness.

COPPER

The most distinguishing characteristic of copper is its reddish color. It is heavy, very ductile and very malleable, and next in tensile strength to iron and nickel. Copper becomes hard and brittle when hammered or wire drawn, and it is annealed to restore its ductility by sudden cooling, which is just the opposite of steel. It can be forged either hot or cold, but it is seldom cast on account of the difficulty of obtaining sound, strong castings. Its melting point is over 2,000 degrees F. It is very hard to machine.

Copper is a constituent of many very useful alloys to which it imparts the element of toughness. Bronze is an alloy of copper and tin. Brass is an alloy of copper and zinc. Where the alloy contains all three metals it is, strictly speaking, a bronze or a brass according as the tin or the zinc predominates.

Unalloyed copper is required by the shipbuilder chiefly for the following purposes:

Steam and exhaust piping.
Large suction and discharge pipes.
Piping or tubing where a rapid transfer of heat through the metal is desired.
Gasoline piping.
Expansion bends on piping generally.
Stern tubes of large wooden vessels.
Fastenings of small wooden vessels.
Gasoline and oil tanks.
Pans under tanks, etc.
Bus bars, ground wires and other electrical work.
Name plates.
Floats for tanks.
Joints and ferrules.
Liners.
Washers.
Engineer's hammer.
Sheet copper for engineers' stores, usually about No. 16 gage.
Soft copper wire for engineers' stores, usually 1/16 inch diameter.

Sheet copper to be made up into pressure piping should be ordered hot rolled, and it should be of good quality, free from sulphur and other impurities. The commercial metal known as "Lake Copper," which is obtained in the neighborhood of Lake Superior, is very pure and both it and electrolytic copper can be readily obtained 99.5 percent pure, which purity should be called for.

Joints of copper piping are made by brazing, or hard soldering, with an alloy of copper and zinc. Joints of copper tanks, etc., are made by riveting and soft soldering with an alloy of tin and lead, or by brazing or soft soldering alone, according to the nature of the service.

Copper sheathing, so called, on wooden vessels is now principally some alloy containing copper, which is cheaper and just as durable and serviceable as the pure copper.

Copper was formerly used extensively for the fastenings of wooden vessels, but it is now used very little for this service except in small vessels of light construction. A number of old sailing vessels have in recent years been burned in order to obtain the copper in them. Early in 1916 the writer figured up, for a purchaser, the value of the copper fastenings of one of the old frigates that made a name for herself in the war of 1812 as being at least $40,000.

LEAD

Lead is a heavy bluish white, lustrous metal which is very malleable and ductile, may be easily scratched with the finger nail and flows under very light strain. It has the least tensile strength of any of the metals of commerce except antimony and melts at about 600 degrees F. Like tin and zinc it becomes brittle as the melting point is reached. Joints of lead sheets, pipes, etc., are made with soft solder.

None of the soft metals possesses greater anti-friction properties than lead, and, if it were hard enough to be retained in the recesses of bearings, it would be of great value for light high speed service without alloying with other metals; hence its use in babbitts. A little lead is of value in bearing bronzes, as will be explained later. Lead is also of value in other alloys to improve the machining qualities and as a softening and cheapening element, also for making solder.

Apart from its use in alloys, lead is required by the shipbuilder chiefly for the following services; and when in the form of sheets or piping it should be specified to be 99.5 percent pure.

Floor covering and flashing in toilet rooms and refrigerated rooms.
Lining for deck machinery foundations.
Stern tubes of small wooden vessels.
Lining in rudder ports of wooden vessels.
Lining in way of hawse pipes, sea valves and other holes through the planking and ceiling of wooden vessels.
Lining of window pockets.
Lead pipe for various services.
Lead bends for bilge and ballast piping.

*Member of Rossell and Thayer, naval architects and marine engineers, Philadelphia, Pa.

Covering for deck steam piping supports of steel or wood.
Protection plates on bottoms of wood doors and on door sills and stair treads.
Thimbles around steam pipes through wood decks, etc.
Dumbwaiter and window weights.
Sounding leads.
Gaskets.
Lead engineer's hammer.
Keels for sailing yachts.
Ballast in sailing yachts.
Sheet lead for engineers' stores, about 1/16 inch thick.
Soft lead wire for engineers' stores, about No. 14 gage.

Nickel

Nickel is a silvery white metal with a strong lustre, which does not tarnish on exposure to air. It is ductile, hard, very difficult of fusion and has the tensile strength of iron.

The shipbuilder has little use for this metal except as a constituent of alloys which are to be used where subject to high heat, erosion by steam, or erosion and corrosion by water, to a marked degree.

The nickel as ordered should be specified to contain at least 97 percent of pure nickel.

Tin

Tin is a white, lustrous, soft, malleable metal with little tensile strength but considerable ductility. It becomes brittle, however, at a temperature of 400 degrees F. and melts a few degrees above that.

Tin is principally used as a constituent of bronzes, babbitts and solders; its effect generally is to impart hardness.

Apart from its use in alloys, tin is required by the shipbuilder chiefly for—

Lining bins, lockers, etc., for stewards' and galley stores.
Thin liners in bearing boxes.
Protection of copper and compositions containing it from the action of alkalies, such as the coating of condenser tubes.
Filling for fusible plugs.

Banca tin, known also as Straits Tin, is considered the best and therefore usually commands the highest price in the market. Tin when ordered should be specified to be at least 99.6 percent pure.

Zinc

Metallic zinc is a bluish white metal, ductile and malleable though to a much less extent than copper, and with slight tensile strength. Its malleability is confined to very narrow limits of temperature below which it is too hard to work and above which it becomes brittle. It melts at about 800 degrees F. It is known to the trade as "spelter."

Zinc is practically non-corrosive in the atmosphere and a coating of it is therefore of value in protecting iron or steel from corrosion. This coating may be applied in three ways —by hot galvanizing, electro-galvanizing or sherardizing.

Zinc is the most strongly electro-positive of the metals of commerce and is therefore of great value in preventing the destruction of iron or steel when immersed in salt or impure water in company with a less electro-positive metal than the iron or steel.

Zinc is used very extensively in the making of alloys. It acts as a flux; also to reduce the cost.

Apart from its use in alloys, zinc is required by the shipbuilder chiefly for—

Lining bins, lockers, etc., for stewards' and galley stores.
Galley sinks.
Letters for vessel's name and hailing port.
Wire rope sockets.
Protection against hull corrosion from electrolytic action.
Protection against boiler corrosion from electrolytic action.
Protection against corrosion in the water spaces of condensers against electrolytic action.
Plates for engineers' stores—spares for the above mentioned boiler service.

The zinc as ordered should be specified to contain at least 98.5 percent of pure zinc and not over .08 percent of iron. Slabs ordered for anti-corrosive service should be rolled, as a more solid, homogeneous slab and smoother surface are thereby obtained, resulting in longer life and better qualities as the anode of an electric battery.

Alloys, General

Having given some consideration to the principal metals used in shipbuilding we will now take up some of the more useful of their alloys of two classes—brass and bronze. Brass as previously stated is an alloy of copper and zinc, whereas bronze is an alloy of copper and tin. We will classify as a brass those copper, zinc, tin alloys which contain more zinc than tin; and we will consider as a bronze copper, tin, zinc alloys which contain more tin than zinc.

The alloys employed by the Bureau of Engineering of the Navy Department will be referred to as Navy compositions.

Brasses

The brass of commerce is usually an alloy of from ⅔ to ⅞ of copper and ⅓ or less of zinc, with a little lead added to soften it and make it machine more easily and a little tin to strengthen and harden it.

Brass Castings

Mixtures for castings most frequently met with in shipbuilding are—

(1) Copper 84 percent to 86 percent, zinc 16 percent to 14 percent, with allowable impurities of not over .3 percent of lead, .06 percent of iron, and .04 percent of other impurities.
This is the Navy composition F, called brazing metal. It is used for flanges and fittings that are to be brazed to copper pipe.

(2) Copper 80 percent to 88 percent, zinc 12 percent to 4 percent, tin 3 percent, lead 5 percent.
This is a composition used for hand wheels of valves.

(3) Copper 84 percent, zinc 8 percent, tin 6 percent, lead 2 percent.
This alloy although having the copper and zinc content of (2) is almost a bronze on account of the higher percentage of tin. It is used by some shipyards for a great variety of work, such as rudder pintle casings, gear wheels, racks, lugs and other castings of ventilator operating gear, fairleads, airports, deck plates and stuffing boxes, valves including the disks and seats, and some of the less important machinery bearings.

(4) Copper 86.5 percent, zinc 9.5 percent, tin 1.5 percent, lead 2.5 percent.
This is the alloy adopted by the Emergency Fleet Corporation as standard for cast hardware of every description, and is of value for such service.

(5) Copper 80 percent, zinc 14 percent, tin 2 percent, lead 4 percent.

(6) Copper 77 percent to 83 percent, zinc 19 percent to 10 percent, tin 4 percent, lead 3 percent, as a maximum, with allowable impurities of not over .2 percent of iron. This is the Navy composition S-c.
These alloys and others of about these proportions are used for—
Screwed pipe fittings.
Deck plates and caps.
Deck stuffing boxes and caps.
Manhole rings, covers and gratings.
Drain plugs.
Screw fitted oil cups, etc.

(7) Copper 62 percent, zinc 37 percent, tin 1 percent.

(8) Copper 60 percent to 65 percent, zinc 39.5 percent to 33.5 percent, tin .5 percent to 1.5 percent with not over 1.0 percent of lead, .5 percent of iron and .5 percent of aluminum This is Navy composition N-c for cast naval brass.
This alloy is used where strength or incorrodibility or both are factors but it is difficult to machine. It is not suitable for bearings or water pressure fittings. Some uses are—
Skylight and chest hinges.
Valve bodies and fittings on ventilation systems, etc.
Plumbers' flanges.
Ornamental and miscellaneous castings.
Name letters.
Scupper pipes and flapper valves.
Steel door and hatch fittings.
Rail and awning stanchions and fittings.
Davit steps and guides.
Strainer plates.
Under water rudder stops on wooden ships.
Valve hand wheels.
Cast studs and nuts.

(9) Copper 62 percent, zinc 30 percent, lead 3 percent, iron 2 percent, with 3 percent of nickel or tin, or nickel and tin. This is the Navy Department composition E-c for commercial brass.

This alloy is of value for—
- Name and number plates.
- Cases for instruments.
- Oil cups.
- Distribution boxes.
- Protection of joiner work.

MANGANESE BRONZE

Manganese bronze is in reality a brass. It was invented by Mr. P. M. Parsons whose compositions are extensively used in this country as well as in England. Manganese is a deoxidizing agent and its use increases the strength, ductility and homogeneousness of the alloy, which is remarkably hard, tough and elastic.

(10) Copper 53 percent to 62 percent, zinc 45 percent to 36 percent, tin 2 percent.

(11) Copper 55 percent to 60 percent, zinc 42 percent to 38 percent, tin 0 percent to 1.5 percent, manganese 0 percent to 3.5 percent, aluminum 0 percent to 1.5 percent, iron .1 percent to 2 percent and lead as an impurity up to .2 percent. This is the Navy composition Mn-c.

(12) The Bureau of Engineering is revising the above specifications and these revised specifications will be ready for issue in the near future. A maximum iron content of 2 percent is permitted.

Manganese bronze is used extensively for propellers and other work requiring great strength and incorrodibility. The uses for which this alloy is specially adapted are—
- Solid propellers.
- Propeller blades.
- Rudders and rudder fittings.
- Stuffing boxes and stern bearings of wooden vessels.
- Propeller blade bolts.

ROLLED OR DRAWN BRASS

Mixtures for rolled or drawn brass most frequently met with in shipbuilding are—

(13) Copper 80 percent to 85 percent, zinc 20 percent to 15 percent, with allowable impurities of not over .1 percent iron and not over .5 percent lead.

This alloy is used for the manufacture of rigid seamless and lock seam voice tubing and is the Navy composition for the latter.

(14) Copper 70 percent, zinc 29 percent, tin 1 percent, with allowable impurities of not over .075 percent lead and .06 percent iron. This is the Navy composition A, called Admiralty metal.

This alloy is of value for—
- Condenser tubes.
- Distiller tubes.
- Evaporator tubes.
- Feed water heater tubes.
- Condenser ferrules.

(15) Copper 60 percent, zinc 40 percent.

(16) Copper 59 percent to 62 percent, zinc 41 percent to 38 percent, with allowable impurities of .6 percent lead and .2 percent iron.

This is the Navy composition D-r for Muntz metal.

MUNTZ METAL

This alloy is named Muntz metal after its inventor, who discovered that extreme proportions of 50 percent copper to 50 percent zinc, and 63 percent copper to 37 percent zinc, and all intermediate values, would roll and work at a red heat. As too much copper increased the difficulty of working the metal and too much zinc rendered the metal too hard when cold, he preferred the alloy to consist of about 60 percent copper and 40 percent zinc. The Bureau of Engineering of the Navy Department calls the cast metal of the above composition Muntz metal also and designates it as D-c, the specification being identical to the above except that iron is not referred to.

This alloy was at one time considered more durable than copper for ship sheathing and equally as efficient, and it almost entirely replaced copper for that purpose. It was found, however, that the corrosive action of sea water caused the alloy to decay. This alloy is of value for—
- Construction plates, shapes and bars not subject to the action of sea water.
- Bolts and nuts and other fastenings not subject to the action of sea water.
- Piston rods of fresh water pumps.
- Sheathing of fresh water vessels.
- Condenser tubes, when tinned.
- Sheets for flexible voice tubing.
- Pipes, iron pipe sizes or plumbers' sizes.

(17) Copper 60 percent to 70 percent, zinc 40 percent to 30 percent, with allowable lead not over .5 percent.

This alloy is used for making up flexible metallic voice tubing, but Muntz metal will answer the purpose as well.

(18) Copper 65 percent, zinc 33 percent, lead 2 percent.

(19) Copper 59 percent to 68 percent, zinc 41 percent to 32 percent, with a maximum of 1.5 percent tin and 3 percent lead and with maximum allowable iron of .2 percent.

This is the Navy composition B-r for rolled commercial brass. It is used for—
- Oil tanks and drip pans.
- Brass oil and water piping.
- Sheet brass for liners.
- Protection of joiner work.
- Hand rails.
- Name and number plates.

(20) Copper 62 percent, zinc 37 percent, tin 1 percent.

(21) Copper 59 percent to 63 percent, zinc 40.5 percent to 35.5 percent, tin .5 percent to 1.5 percent, with maximum allowable impurities of .2 percent lead and .06 percent iron. This is the Navy composition N-r for rolled naval brass.

Like the cast naval brass this alloy is used where strength or incorrodibility or both are factors. It will be noted that it is practically Muntz metal with a small addition of tin; and this small amount of tin is found to protect it against the corrosive action of sea water referred to above. It is of value for—
- Construction plates, shapes and bars.
- Moldings and chafing bars.
- Condenser tube sheets and ferrules.
- Condenser tube supporting plates.
- Sheathing of wooden ships.
- Operating rods.
- Pump rods.
- Studs and nuts.
- Pins.
- Pipe casings for piston rods and plungers.

MANGANESE BRONZE

The nature of this alloy has been explained under the heading of brass castings. It is also suitable for forgings.

(22) Copper 57 percent to 60 percent, zinc 40 percent to 37 percent, tin .5 percent to 1.5 percent, manganese not over .3 percent, iron not over 2.0 percent and lead not over .2 percent. This is the Navy composition Mn-r for rolled manganese bronze.

This alloy is of special value for rods requiring great strength where subject to corrosion, particularly the corrosion of salt water. Some of its uses are—
- Valve stems.
- Operating rods.
- Propeller blade bolts.
- Air pump bolts.
- Condenser bolts.
- Stuffing box bolts and studs.
- Sheathing of wooden ships.
- Machine bolts and nuts generally.

TOBIN BRONZE

(23) Tobin bronze is a proprietary composition whose exact mixture is not published by its manufacturers. Analyses of the metal as found in engineering handbooks show it to be very similar in composition to (22) though with less iron and no manganese. It meets the requirements of the Navy specifications (21) for rolled naval brass, which allow only .06 percent iron, and probably contains a fraction of a percent of other metals used by the makers to bring about the desired results.

This composition has great tensile and torsional strength and great resistance to the corrosive action of sea water. Results from its use have been consistently successful, and it has been found to be a most desirable alloy for—
- Plates and shapes of bronze yachts and other vessels where in contact with salt water.

Rudders and rudder stocks.
Condenser tube sheets.
Condenser tube supporting plates.
Pump valves.
Pump rods and valve stems.
Propeller shafts of small vessels in salt water service.
Wooden ship sheathing.
Hinge pins.
Bolts, screws, nails and other fastenings in contact with salt water.
Deck and spar fittings of yachts.

Bronzes

Turning our attention now to the true bronzes, we find a number of alloys that are of particular value for severe duty along various lines. With copper and tin as the principal elements, zinc is added to soften them and assist in making sound castings and lead, as with brass, is a softening element and improves the machining qualities. There are other metals sometimes introduced for special purposes which will be explained later. The hardness of bronze varies almost directly with the percent of tin in the mixture. Good alloys may be made which contain as much as 20 percent of tin but bronzes with 25 percent of tin or more are valueless to the shipbuilder.

All straight bronzes should be rejected which contain sulphur in an appreciable amount, more than .1 percent of arsenic and antimony united and more than .06 percent of iron.

Bronze Castings

Mixtures for castings most frequently met with in shipbuilding are—

(24) Copper 88 percent, tin 10 percent, zinc 2 percent.

(25) Copper 87 percent to 89 percent, tin 11 percent to 9 percent, zinc 1 percent to 3 percent, with allowable impurities of not over .2 percent of lead and not over .06 percent of iron. This is the Navy formula G for gun metal, of which (24) is the usual shipyard version.

This alloy is of particular value for castings where strength or resistance to corrosion, or both, at ordinary temperature are required; but it loses its strength rapidly with increase of temperature above 500 degrees F. It is of particular value for—

Spring and strut bearings of shafting.
Bearing boxes of blowers.
Distance pieces in journal boxes.
Stern tubes or bushings.
Shaft and rudder stock liners or sleeves.
Propeller nut caps.
Pump casings.
Pump valve seats and buckets.
Valves bodies 4 inches diameter and over except for superheated steam.
Seats and disks in high pressure steam valves.
Expansion joints.
Pipe flanges.
Pipe fittings.
Gear wheels.
Bolts and nuts.
Pad eyes and ring bolts.
Stuffing boxes and bushings.

(26) Copper 83 percent, tin 13.5 percent, zinc 3.5 percent.

(27) Copper 82 percent to 84 percent, tin 14.5 percent to 12.5 percent, zinc 2.5 percent to 4.5 percent, lead 1 percent as a maximum with allowable iron up to .10 percent. This is the Navy formula H for journal bronze.

This alloy is essentially a bearing metal and is of value for all such service where its tendency to brittleness, due to the high tin content, is not a drawback. Ordinary uses are—

Bearings.
Journal boxes.
Journal bushings.
Suspension link brasses.
Sleeves.
Slippers.
Guide gibs.
Link block gibs.
Piston rod and valve stem neck and gland bushings of main engines.
Wedges on watertight doors.

(28) Copper 87 percent, tin 7 percent, zinc 5 percent to 6 percent, lead 1 percent as a maximum, with allowable iron up to .06 percent. This is the Navy formula M for valve bronze.

This alloy is almost a brass, rather than a bronze, being quite close in composition to (3). It has too much zinc for severe steam pressure service, but is of value for—

Bodies of valves below 4 inches, for steam and general purposes.
Manifolds.
Cocks.
Hose couplings and fittings.
Stuffing box glands and gland bushings.
Castings of skylight and ventilator operating gear.
Lug sockets and pad eyes requiring no special strength.
Bitts, chocks, cleats and fairleads.
Airports.
Sea connections.

(29) Copper 78 percent, tin 22 percent.

This alloy is bell metal, for ships' bells, and should be made of new Lake Superior copper, or equal, and new block tin.

Phosphor Bronze

This is a bronze alloy which has been given exceptional purity and excellence by skilful fluxing with phosphorus. Copper, tin and lead tend to form oxides readily, and phosphorus, like manganese, is an excellent deoxidizer and thus prevents structural weakness. It is usually added in excess of the amount required for this purpose and when so added increases the value of the alloy as a bearing metal, as explained under the heading of bearing metals. The resultant alloy is harder and stronger than ordinary gun metal, and very close grained.

(30) Copper 89 percent, tin 10.5 percent, phosphorus .5 percent.

This composition is of value where a very hard bearing metal is desired for such service as liners for connecting rod wrist pins in Diesel engines.

(31) Copper 78 percent to 82 percent, tin 9 percent to 11 percent, lead 9 percent to 11 percent, phosphorus .1 percent to .25 percent.

This composition has been adopted by one or more of the large manufacturers of marine engines for heavy pressure and high speed bearings and those subjected to shock and vibration.

(32) Copper 85 percent to 90 percent, tin 11 percent to 6 percent, zinc 4 percent maximum, phosphorus .5 percent maximum, with allowable lead up to .2 percent and allowable iron up to .06 percent. This is the Navy composition P-c, grade 1.

(33) Copper 85 percent to 90 percent, tin 11 percent to 6 percent, zinc 9 percent to 4 percent, phosphorus .5 percent maximum, with allowable lead up to 1 percent and iron up to .1 percent. This is the Navy composition P-c, grade 2.

This alloy is of special value for items which are exposed to the action of salt water and require good bearing qualities. Grade 2 should be used only where great strength is not required. An alloy at the high limit of the tin and phosphorus is much harder than one at the low limit. The special uses are—

Driving nuts of hand steering gears.
Worm gears.
Gear wheels on steering rods.
Cast piston rods and pump rods.
Shaft liners and pump casings.
Rudder pintle casings.
Machinery bearings where journal bronze might prove too brittle.
Slide valves.
Bearing rings.

Rolled or Drawn Bronze

Bronzes do not lend themselves readily to forging operations. An alloy with as much as 5 percent tin can only be worked hot and with 15 percent of tin it cannot be forged hot or cold. It is perhaps for this reason that Tobin bronze, manganese bronze and other rolled brass alloys are able to

appropriate the name of bronze. Rolled or drawn phosphor bronzes containing small percentages of tin are, however, of great value to the shipbuilder.

(34) Copper not less than 94 percent, tin not less than 3.5 percent, phosphorus .05 percent to .5 percent, with allowable impurities of not over .3 percent zinc, .1 percent iron and 2 percent lead, and with the total content of copper, tin and phosphorus not less than 99 percent. This is the Navy composition P-r.

This alloy is of value for—
- Valve stems.
- Pump rods.
- Pump valves.
- Bolts, screws, etc.
- Wire rope.

For rods, bolts and wire the low limit of tin, and phosphorus not to exceed .1 percent, are the most desirable.

(35) Copper 94 percent, tin not less than 4.5 percent, phosphorus .05 percent to .5 percent, with allowable impurities of not over .3 percent zinc, .1 percent iron and .2 percent lead. This is the Navy composition for spring wire, hard drawn or hard rolled.

This alloy is of value for such service as—
- Slide valve packing ring springs.
- Valve springs.

Special Alloys

A few special alloys which do not have copper and zinc or copper and tin as their principal elements will be now considered.

Monel Metal

Monel metal is a natural alloy containing 67 percent to 68 percent nickel, 28 percent to 30 percent copper and 2 percent to 5 percent of other metals, principally iron. The proportions are practically the same as those of the ore as it comes from the only known deposit, a mine near Sudbury, in Ontario, Canada. The iron is in the original ore and small quantities of manganese, silicon and carbon are introduced in the process of refining.

Monel metal is non-corrodible, tough and ductile. It has the appearance of steel though it is difficult to distinguish from pure nickel and takes and retains a nickel polish. It can be cast, forged, rolled, drawn, welded, brazed or soldered; and it is comparatively easy to machine. The tensile strength of the rolled metal exceeds nickel steel at ordinary temperatures, and at a high temperature it is far superior to nickel steel. It is remarkably free from erosion or corrosion by steam or water; shows little wear when used for pump liners and acquires a glass like surface. It has a coefficient of expansion very similar to that of steel, which together with its resistance to the effects of heat has led to its use for valve stems, disks and seats in cast steel valves for superheated steam work.

(36) The Navy formula for Monel metal, either cast or rolled, is nickel not less than 60 percent, copper not less than 23 percent, iron not over 3.5 percent, manganese not over 3.5 percent, aluminum not over .5 percent, and carbon and silicon combined not over 2.0 percent.

This alloy is of special value for—
- The highest grade of propeller blades.
- Turbine blading.
- Condenser tubes.
- Valves, valve stems, liners and piston rods of salt water pumps.
- Composition fittings in the refrigerating system.
- Valves and valve seats of internal combustion engines.
- Disks, seats and stems of valves handling superheated steam.
- Disks and seats of boiler safety valves.
- Engine framing.
- Boat fittings.

Aluminum Bronze

Aluminum bronze is a mixture of copper and aluminum with usually a small percentage of iron. It is one of the strongest and most valuable bronzes yet discovered, but its high cost when first discovered and more recently the difficulty experienced in handling it in the foundry, when the cost of aluminum came down, have to date militated against its extensive use in the shipbuilding field. It is malleable at red heat.

(37) Copper 88.5 percent to 89 percent, aluminum 10 percent, iron 1 percent to 1½ percent.

This alloy is very valuable for worm gears and similar service.

Bearing Metals

Turning our attention now to bearing metals we find that a bearing metal has to fulfill many requirements, among the most important of which are—

(a) The hardest element in it must be softer than the shaft or pin so as not to injure them.
(b) The metal should be plastic to a limited degree for the reason that the fitting of it is only an approximation and also to enable it to conform to a change in alinement of the shaft. It should, however, be strong enough to carry the load without distortion.
(c) It should show small friction. This for such duties as are met with on shipboard calls for a surface that will retain the lubrication.
(d) It should conduct and radiate the heat of friction readily.
(e) It should be of a nature not to weld to the shaft in case it becomes heated.
(f) It should wear slowly.
(g) It should be capable of uniform production and be easy to handle in the foundry.

Some of the bronzes and the babbitts have the desired combination of properties. Alloys of about two-thirds tin and one-third zinc with a little copper or antimony, called white brass, also make good hard bearing metals; but they are not extensively used on account of their difficult handling. The true brass is not satisfactory because it does not fulfill requirement (c) above, and the expression "bearing brasses" is a misnomer, as far as what is generally known as brass is concerned. A brass bearing is dry and harsh. Bronzes are used where their strength and hardness are necessary to fulfill the particular requirements of the service or to have sufficient life, and babbitts are used for the less severe duties. Bronzes can be given a wide range of hardness by increasing the zinc or lead. Babbitts also have a wide range of hardness and there are many mixtures between the limits of 90 percent tin with no lead and 90 percent lead with no tin. With bronzes the harder element is the major constituent, whereas with babbitts it is the minor constituent. Babbitts are of no value for such service as brasses, gibs, etc., but should only be used when poured and hammered into suitable recesses in the bearing boxes provided for this metal.

The surface of a bronze bearing consists of a hard copper-tin background with softer crystals formed by other elements in composition with the copper or tin, or softer globules of the other elements. These soft crystals or globules wear more rapidly than the background, thus producing small reservoirs which retain the oil. A small amount of phosphorus in excess of that required as a deoxidizer furnishes an additional hard constituent, which is one of the factors in the value of phosphor bronze as a bearing metal. A small amount of lead imparts plasticity to a bearing bronze and also furnishes additional oil reservoirs.

The surface of a tin base babbitt bearing consists of a relatively soft tin background with harder tin-antimony, copper-tin or copper-antimony crystals in it. The background in this case wears first, forming reservoirs which retain the oil. With the lead base babbitts the background is lead or a mixture of lead and tin and the harder crystals are the tin-antimony compound.

This ability to provide oil reservoirs is not a property of the brass alloys, and is the reason for their not being good bearing metals, as previously mentioned.

The Brinell hardness test is of value for determining the properties of a bearing metal, particularly when its general composition is known; and machines for making such tests are readily obtainable. The test consists of indenting the surface of the metal by a hard steel ball of fixed diameter, under a fixed pressure, for a fixed period of time. The hardness figure is the quotient of the pressure applied on the ball divided by the surface of the indentation. This surface can be readily determined from the depth or diameter of the impression, preferably the former. Hardness figures usually met with are for the metal at 70 degrees F.

Bearing Bronzes

These bronzes as most frequently used in shipbuilding have been already presented and their value as bearing metals touched upon. To group them together as bearing metals they are—

(27) Journal bronze-copper 82 to 84 percent, tin 14.5 to 12.5 percent, zinc 2.5 to 4½ percent, lead up to 1 percent.

(32) Phosphorus bronze-copper 85 to 90 percent, tin 11 to 6 percent, zinc 4 percent, phosphorus up to .5 percent and lead up to .2 percent.

The first mentioned alloy takes in the general run of machinery bearings while the second is of particular value where the bearing is of the nature of a nut on a screw, or one gear wheel against another, or shaft bearings in salt water; as may be noted from the lists of service previously given.

White Brasses

These alloys, which have been already referred to, are used in recessed bearings in place of babbitt metal where it is important that the bearing shall have a long life under conditions of severe service. The usual composition met with in shipbuilding fall within the range of tin 60 percent to 65 percent, zinc 33 percent to 28 percent, copper 3 percent to 6 percent with a small amount of lead.

(38) Parsons No. 2 This is a proprietary alloy of the above nature with possibly a slightly higher tin content and possibly a small amount of antimony in place of a part of the copper. It has been used by the writer with very good results for the main bearings and connecting rod bottom ends of reciprocating propelling engines, and thrust shoes.

Tin Base Babbitt

(39) Tin 84 percent, antimony 9 percent, copper 7 percent.

(40) Tin 83⅓ percent, antimony 8⅓ percent, copper 8⅓ percent.

These are about the hardest babbitts in commercial use, the first mentioned having been adopted by the Society of Automobile Engineers and also used in the Liberty motor, and the second adopted by a manufacturer of large heavy oil internal combustion engines.

(41) Tin 80 percent to 83.5 percent, antimony 11 percent to 15 percent, copper 5 percent to 5.5 percent.

This is the Navy composition W, grade B, adopted for all bearings of internal combustion engines.

(42) Tin 79 percent, antimony 13 percent, copper 3¾ percent, lead 4¼ percent.

This is the composition adopted by one of the large manufacturers of Diesel engines in this country for use in all babbitted bearings of these engines.

(43) Tin 91 percent, antimony 4.5 percent, copper 4.5 percent with allowable lead not over .2 percent.

This composition has been adopted by the International Aircraft Standards Board. Its hardness is about 83 percent of that of composition (40).

(44) Tin 88 percent to 89.5 percent, antimony 7 percent to 8 percent, copper 3 percent to 4.5 percent. This is the Navy composition W, grade A, and makes a good hard metal for general use.

(45) Tin 89 3 percent, antimony 3.6 percent, copper 7.1 percent. This is understood to be the composition adopted by Isaac Babbitt, the inventor of the recessed bearing into which bearing metal is poured.

All of these babbitts should have not over .08 percent iron, not over .10 percent arsenic, and no zinc or aluminum.

Tin base babbitt should be used for the great majority of recessed bearings on shipboard. The exceptions are the few cases where change of alinement or low pressure or intermittent service renders the lead base babbitt suitable. The tin base babbitt is very fluid when molten and desirable from this point of view as well as on account of greater hardness and longer life.

Lead Base Babbitt

(46) Lead 75 percent, antimony 15 percent, tin 10 percent.

This is about the hardest lead base babbitt in commercial use. It has about ⅔ the hardness of the hardest tin base babbitt.

(47) Lead 80 percent, antimony 15 percent, tin 5 percent.

This composition with slight variations is marketed with successful results by some of the concerns which make a specialty of lead base bearing metals.

(48) Lead 87 percent, antimony 13 percent.

This is a bearing metal adopted by one of our large railway systems, which claims that the addition of much more antimony will tend to make the metal brittle. It is one of the softest in commercial use.

(49) Lead 76 percent to 80 percent, antimony 18 percent to 13 percent, tin 5 percent to 6 percent, copper 1 percent.

This is the composition adopted by the Emergency Fleet Corporation for this type of bearing metal.

Lead base babbitts should contain not over .2 percent arsenic and no iron.

Lead base babbitt when properly poured is satisfactory for—

Line shaft bearings.
Rudder stock bearings
Miscellaneous bearings for high speed light duty work.
Miscellaneous bearings that are subject to little use.

Solders

Solders are of two kinds, hard and soft. They are made of metals that have an affinity for and melt at a considerably lower temperature than the metals to be united.

The hard solder used for brazing copper pipes is usually a brass composed of about equal amounts of copper and zinc, i.e.:

(50) Copper 50 percent, zinc 50 percent.

Soft solder is usually a mixture of tin and lead, ranging from 50 percent to 33 percent tin and 50 percent to 67 percent lead, the best quality having the highest tin content. The addition of a small amount of antimony lowers the complete liquidation point, but antimony should not be used when galvanized iron or zinc are to be soldered. During the war, in order to conserve tin, consideration was given to the possibilities in the use of cadmium; and a composition consisting of 80 percent lead, 10 percent cadmium and 10 percent tin showed particular promise.

(51) Tin 45 percent, lead 55 percent, with allowable impurities of not over .12 percent antimony, .08 percent copper and .10 percent of other materials.

For hard soldering with an iron this solder will answer for all purposes.

(52) Tin 37.5 percent, lead 62.5 percent with allowable impurities as above.

This is a good wiping solder on account of the proportions of solid and fluid metal in the temperature range of about 110 degrees F. between the point where melting begins and where the solder is completely liquefied.

Summary

In order to illustrate more clearly the uses of the brasses, bronzes and bearing metals which we have been considering, the writer will now present them in order in which ship specifications are usually written, pointing out the alloy called for by good merchant practice for the particular service. Although the alloys thus pointed out are those most generally met with, it should be understood that there are in most cases other alloys of somewhat different composition

which will meet the demands of the service. Alloys which depart materially from general practice should, however, be very carefully investigated unless they have been thoroughly tried out or are required by the owner of the vessel. It should also be understood that in many cases, wrought or cast steel, semi-steel or malleable iron are used for the services mentioned, and sometimes preferably so used.

The designating numbers are those opposite the formulæ as previously given.

Table of Suitable Brasses, Bronzes and Bearing Metals for Ship Specification

	Items	Composition	Formula No.
1A	Hull Fastenings—		
	Fastenings of bronze vessels where exposed to salt water or weather	Tobin bronze	23
	Where not exposed to the above	Muntz metal	16
2A	Structural Items—		
	Plates and shapes of bronze vessels where exposed to salt water or weather	Tobin bronze	23
	Fin keels	Tobin bronze	23
	Interior plates and shapes of bronze vessels	Muntz metal	16
3A	Sheathing—		
	Sheathing of wooden vessels in salt water	Rolled manganese bronze	22
	Sheathing of wooden vessels in fresh water	Muntz metal	16
4A	Rudder—		
	Rudder plates	Tobin bronze	23
	Rudder stocks and posts	Tobin bronze	23
	Cast rudders and arms and pintles of wooden rudders	Cast manganese bronze	12
	Casings on steel pintles	Phosphor bronze	33
	Bearings of composition cased pintles	Tin base babbitt	44
	Underwater rudder stops on wooden ships	Cast naval brass	8
	Sleeve on rudder stock	Gun metal	25
	Rudder bearer ring	Phosphor bronze	33
	Rudder bearer bearing metal with bronze sleeve on stock	Lead base babbitt	49
	Rudder bearer bushing for steel stock	Phosphor bronze	33
	Rudder stuffing box bushing	Valve bronze	28
	Rudder stuffing box gland	Valve bronze	28
	Bearer and stuffing box bolts or studs	Tobin bronze	23
5B	Bulwarks—		
	Castings in way of portable bulwarks, etc	Cast naval brass	8
6B	Steel Doors, Ports and Hatches—		
	Coamings	Cast naval brass	8
	Hinges	Gun metal	25
	Bolts and nuts	Manganese bronze	12 or 22
	Handles	Hardware brass	4
	Bushings for handle bolts	Gun metal or naval brass	25 or 21
	Hinge pins and tumble bolt pins	Tobin bronze	23
	Operating rods	Rolled naval brass	21
	Operating rod gear wheels, worms or nuts	Phosphor bronze	32
	Dogs	Cast naval brass	8
	Dog wedges	Journal bronze	27
	Toggle pins	Rolled naval brass	21
	Rubber packing retainer	Rolled commercial brass	19
	Handhole covers	Screw brass	6
	Wide open and ajar hooks or fittings	Hardware brass	4
	Air vent valve castings	Gun metal	25
	Air vent valve forgings	Rolled naval brass	21
	Hand wheels	Brass	2
7B	Hatches with Wooden Covers—		
	Pad eyes	Gun metal	25
	Ring bolts	Gun metal	25
	Tarpaulin cleats	Cast naval brass	8
	Portable stanchions	Cast naval brass	8
	Portable stanchion sockets	Cast naval brass	8
8B	Ventilation, Light and Access Trunks and Skylights—		
	Frames of lights in steel shutters	Valve bronze	28
	Pins of shutter hinges	Rolled naval brass	21
	Toggle pins	Rolled naval brass	21
	Split pins and safety chains	Rolled commercial brass	19
	Nosings and wearing strips	Naval brass	8 or 21
	Operating rods	Rolled naval brass	21
	Operating rod hangers and rollers	Valve bronze	28
	Operating rod gear wheels, racks, etc	Phosphor bronze	33
	Lifting lugs	Valve bronze	28
	Hand wheels	Brass	2
9B	Mast and Boom Fittings—		
	Bearing rings	Phosphor bronze	33
	Pins for goosenecks, crow's nest, hinges, etc	Tobin bronze	23
10B	Pipe Casings—	Rolled naval brass	21
11B	Moldings and Chafing Bar	Rolled naval brass	21
12C	Bitts, Chocks, Cleats, Fairleads—		
	When all of composition	Valve bronze	28
	Brass caps for wooden bitts	Valve bronze	28
	Babbitt for chocks, bitt heads and thumb cleats	Lead base babbitt	49
13C	Eye bolts and ring bolts*	Gun metal	25
14C	Davit Steps and Guides	Cast naval brass	8
15C	Manholes and Scuttles (See also 6B)—		
	Rings, covers and gratings	Screw brass	6
	Locking studs	Gun metal or naval brass	25 or 21
16C	Fittings for Metal Hatches (See 6B)—		
17C	Freeing Ports, Scuppers and Drains—		
	Deck and hull castings	Cast naval brass	8
	Strainers	Cast naval brass	8
	Flapper valves	Cast naval brass	8
	Freeing port dogs	Cast naval brass	8
	Freeing port hinges	Gun metal	25
	Bolts, studs and nuts	Rolled naval brass	21
	Drain plugs in bottom	Screw brass	6
18C	Airports and Fixed Lights—		
	Frame, rim for glass, ring nuts	Valve bronze	28
	Bolts	Gun metal	25
19C	Ventilators—		
	Ring nuts and pinch screws	Screw brass	6
	Vent operating gear (See 8B)		
20C	Rail and Awning Stanchions, etc.—		
	Stanchions	Cast naval brass	8
	Stanchion and ridge pole heads and feet	Cast naval brass	8
	Spreader sockets	Cast naval brass	8
	Stanchion clamps	Cast naval brass	8
	Rails and rods	Rolled commercial brass	19
	Fittings on wooden rails	Cast naval brass	8
	Bolts and nuts	Rolled naval brass	21
21C	Skylight Fittings— (See 8B)		
22C	Miscellaneous Hull Fittings—		
	Flag pole sockets and guides	Cast naval brass	8
	Deck plates and caps	Screw brass	6
	Deck stuffing boxes and caps	Screw brass	6
	Deck stuffing box glands	Screw brass	6
23D	Joiner Work—		
	Tie rods, bolts, etc., in way of standard compass	Muntz metal	16
	Protection on doors, sills or stairs	Commercial brass	9 or 19
	Fittings on rails, grab rails, etc	Cast naval brass	8
	Hinges	Hardware brass	4
	Pins of steel hinges	Tobin bronze	23
	Ajar hooks and wide open hooks	Hardware brass	4
	Cast hardware generally	Hardware brass	4
24E	Name Plates, etc.—		
	Ship and engine name plates	Commercial brass	9 or 19
	Letters for name and hailing port	Cast naval brass	8
25F	Cables, Lines and Rigging—		
	Ropes	Phosphor bronze	34
	Cable shackle pin keepers	Rolled naval brass	21
26F	Blocks—		
	Bushings for sheaves	Phosphor bronze	33
27F	Ship's Bells—		
	Body	Bell metal	29
	Clapper and pin	Gun metal	25
28F	Accommodation Ladder, Leadsman Platform, etc.— (See 20C and 23D)		
29G	Hull Machinery—		
	Piston rods and valve stems	Tobin bronze	23
	Crosshead and crank pin brasses	Journal bronze	27
	Stuffing boxes or neck bushings	Gun metal	25
	Glands or gland bushings	Valve bronze	28
	Gland studs	Rolled naval brass	21
	Slippers	Journal bronze	27
	Slide valves	Phosphor bronze	32
	Worm gears	Phosphor bronze	32
	Babbitted bearings	Lead base babbitt	49
30G	Steering Gear— (Engine same as 29G) (See also 4A)		
	Steering stands	Cast commercial brass	9
	Shafting in pilot house	Rolled manganese bronze	22
	Bevel gears	Phosphor bronze	32
	Rod stuffing boxes and glands	Screw brass	6
	Universal joints	Phosphor bronze	32
	Sheaves or sheave bushings	Phosphor bronze	33
	Screw gear operating nuts	Phosphor bronze	32
	Babbitted bearings	Lead base babbitt	49
	Tiller rope	Phosphor bronze	34
31G	Fire Main and Deck Wash System—		
	Hose connection and cap	Valve bronze	28
32G	Water Ballast and Bilge System—		
	Strainer plates	Cast naval brass	8
33G	Sanitary and Drainage Systems—		
	Brazed fittings	Brazing metal	1
	Screwed fittings	Screw brass	6
	Scupper pipes	Cast naval brass	8
	Flapper valves and clappers	Cast naval brass	8
	Pipes	Muntz metal	16
	Tubing	Admiralty metal	14
34G	Deck Pumps—		
	Casing in water cylinder	Gun metal	25
35G	Steam Heating and Steam Service—		
	Radiator fittings	Commercial brass	9 or 19
	Stuffing boxes and glands	Screw brass	6
	Radiator shields	Rolled commercial brass	19
	Pipes	Muntz metal	16
36G	Refrigerating Machinery— (See similar items of main machinery where compositions are called for)		

	Items	Composition	Formula No.
37G	**Interior Communication—**		
	Rigid voice tubing	Brass	13
	Flexible voice tubing	Muntz metal	16
	Pulleys for telegraph chain	Cast commercial brass	9
	Telegraph chain	Rolled commercial brass	19
38H	**Main Engine—Reciprocating—**		
	Piston ring tongue piece	Gun metal	25
	Piston ring tongue piece pins	Tobin bronze	23
	Tap bolts in cylinders and valve chests for liners, etc	Tobin bronze	23
	Screws for false face on slide valves	Tobin bronze	23
	Slide valve packing ring connection pieces	Gun metal	25
	Slide valve packing ring springs	Phosphor bronze	35
	Sockets and caps for above	Gun metal	25
	Piston rod and valve stem neck and gland bushings	Journal bronze	27
	Gland studs and nuts	Rolled manganese bronze	22
	Valve stem brasses	Journal bronze	27
	Valve stem nuts	Gun metal	25
	Valve stem box distance pieces	Gun metal	25
	Valve stem box shims	Rolled commercial brass	19
	Valve stem guide boxes and yoke bushings	Journal bronze	27
	Connecting rod top and bottom end box and cap when not babbitted	Phosphor bronze	32
	Babbitted bottom end	White brass	38
	Distance pieces at both ends	Gun metal	25
	Shims at both ends	Rolled commercial brass	19
	Crosshead slippers	Tin base babbitt	44
	Crosshead slipper liners	Cast naval brass	8
	Eccentric strap bearing	Tin base babbitt	44
	Eccentric strap distance pieces	Gun metal	25
	Eccentric strap shims	Rolled commercial brass	19
	Eccentric rod brasses	Journal bronze	27
	Eccentric rod distance pieces	Gun metal	25
	Eccentric rod shims	Rolled commercial brass	19
	Link block gibs	Journal bronze	27
	Drag link brasses	Journal bronze	27
	Drag link box distance pieces	Gun metal	25
	Drag link box shims	Rolled commercial brass	19
	Valve stem guide brasses	Journal bronze	27
	Main bearings	Phosphor bronze	32
	Bearing metal for main bearings	White brass	38
	Main bearing distance pieces	Gun metal	25
	Main bearing shims	Rolled commercial brass	19
	Thrust bearings	Tin base babbitt	44
	Thrust shoes	White brass	38
	Thrust rod nuts	Manganese bronze	12 or 22
	Thrust glands	Valve bronze	28
	Thrust gland studs	Rolled manganese bronze	22
	Pipe connections for thrust circulating water	Screw brass	6
	Drain plugs for thrust shoes	Screw brass	6
39H	**Reversing Engine—**		
	Piston rod and valve stem gland and neck bushings	Gun metal	25
	Valve stem eye socket	Gun metal	25
	Gland nuts	Rolled naval brass	21
	Connecting rod boxes	Journal bronze	27
	Crosshead	Gun metal	25
	Guide bushings	Journal bronze	27
	Drag rod bushings	Journal bronze	27
	Shaft bearings	Tin base babbitt	44
	Link block of valve gear	Journal bronze	27
	Composition parts of handling gear, latch lever, hand wheel, clamp, etc	Brass	2
40H	**Turning Engine—**		
	Valve stem sleeve	Gun metal	25
	Piston rod and valve stem gland and neck bushings	Valve bronze	28
	Connecting rod brasses when not babbitted	Phosphor bronze	32
	Babbitted bottom end	Tin base babbitt	44
	Slipper babbitt metal	Lead base babbitt	49
	Crosshead brasses	Journal bronze	27
	Eccentric rods	Gun metal	25
	Eccentric strap bearing	Journal bronze	27
	Guide bracket bushings	Journal bronze	27
	Bedplate bearings	Lead base babbitt	49
	Valve gear link block	Journal bronze	27
	Worm shaft washers	Journal bronze	27
	Bearing box distance pieces generally	Gun metal	25
	Bearing box shims generally	Rolled commercial brass	19
	Hand wheel and clamp of hand lever lock	Brass	2
41H	**Attached Pump Connections—**		
	Rocker shaft bearing bushings	Journal bronze	27
	Pump link boxes	Journal bronze	27
	Crosshead boxes	Journal bronze	27
	Guide bracket bushings	Journal bronze	27
	Bearing box distance pieces generally	Gun metal	25
	Bearing box shims generally	Rolled commercial brass	19
42H	**Throttle Valve—** (See also 67S and 68S)		
	Butterfly valve	Gun metal	25
	Butterfly valve gland and neck bushing	Gun metal	25
	Hand wheel and clamp of hand lever lock	Brass	2
43H	**Propelling Turbine—**		
	Nozzles	Monel metal	36
	Blades	Monel metal	36
	Babbitted bearings	Tin base babbitt	44
44H	**Diesel Engine—**		
	Connecting rod wrist pin liners	Phosphor bronze	30
	Valves and valve seats	Monel metal	36
	Bearing metal	Tin base babbitt	41
45H	**Line Shafting—**		
	Bearings	Lead base babbitt	49
	Bulkhead stuffing box or neck bushing	Gun metal	25
	Bulkhead stuffing box gland or gland bushing	Valve bronze	28
46H	**Propeller Shaft—**		
	Shaft of salt water launches	Tobin bronze	23
	Liner or sleeve on steel shaft	Gun metal	25
	Strut bearings	Gun metal	25
47H	**Stern Tube and Fittings—**		
	Stern tube or after bushing	Gun metal	25
	Forward neck bushing	Gun metal	25
	Gland or gland bushing	Valve bronze	28
	Bolts to fasten gland halves	Rolled manganese bronze	22
	Gland studs	Rolled naval brass	21
	Bolts or studs fastening aft bushing to tube or tube to hull	Tobin bronze	23
	Retaining strips for lignum vitæ	Naval brass	8 or 21
	Retaining ring for ends of lignum vitæ	Cast naval brass	8
	Retaining ring studs	Tobin bronze	23
	Stern tube nut	Gun metal	25
48H	**Propeller Shaft Stuffing Boxes of Small Wooden Vessels—**		
	Combined bearer and stuffing box when not babbitted	Gun metal	25
	When babbitted	Cast manganese bronze	12
	Bearing metal	Tin base babbitt	44
	Bolts and lag screws	Cast manganese bronze or Tobin bronze	12 or 23
49H	**Stern Bearings of Small Wooden Vessels (See 48H)**		
50H	**Propellers—**		
	Solid propellers	Cast manganese bronze	12
	Blades and bolts	Cast manganese bronze	12
	Propeller nut and lock screw	Cast manganese bronze	12
	Propeller nut cap	Gun metal	25
	Propeller nut cap bolts or studs	Tobin bronze	23
	Propeller nut wrench eye bolts	Gun metal	25
51J	**Main and Auxiliary Condenser—**		
	Tube sheets	Rolled naval brass	21
	Tube supporting plates	Rolled naval brass	21
	Tubes	Admiralty metal	14
	Tube ferrules	Rolled naval brass	21
	Stay rods	Rolled naval brass	21
	Bolts and studs in salt water spaces	Tobin bronze	23
	Bolts and studs not subject to salt water	Muntz metal	16
52K	**Attached Air Pumps—**		
	Pump barrel	Gun metal	25
	Piston rod liner	Gun metal or naval brass	25 or 21
	Piston rod nut	Gun metal	25
	Piston rod guide brasses	Journal bronze	27
	Gland bushing	Valve bronze	28
	Gland studs	Tobin bronze	23
	Bucket follower	Gun metal	25
	Bucket key pieces	Gun metal	25
	Delivery valves	Phosphor bronze	34
	Delivery valve seats	Gun metal	25
	Delivery valve guards	Gun metal	25
	Snifting valve	Gun metal	25
	Snifting valve seat	Gun metal	25
	Bolts and studs in pump	Tobin bronze	23
	External nuts	Rolled naval brass	21
	Strainer plates	Cast naval brass	8
53K	**Attached Feed and Bilge Pumps—**		
	Liner	Gun metal	25
	Cast plunger	Gun metal	25
	Pipe plunger	Rolled naval brass	21
	Gland and neck bushings	Gun metal	25
	Gland studs	Rolled naval brass	21
	Bottom plug in plunger	Gun metal	25
	Valve and valve guards	Gun metal	25
	Valve seats	Gun metal	25
	Valve spindle	Tobin bronze	23
	Valve springs	Phosphor bronze	35
	Valve spring guides, bushings, spindle nuts, cap nuts and ring nuts	Gun metal	25
54K	**Independent Plunger Pumps—** (In general as stated for the attached pumps)		
	Piston in water cylinder	Gun metal	25
	Piston follower	Gun metal	25
	Piston rod	Tobin bronze	23
	Piston rod nut	Naval brass	21
	Liner in air or water cylinder	Gun metal	25
	Follower studs and nuts	Tobin bronze	23
	Springs	Phosphor bronze	35
55K	**Centrifugal Pumps—**		
	Impeller	Gun metal	25
	Wearing rings	Journal bronze	27
	Shaft	Tobin bronze	23
	Sleeve on steel shaft	Gun metal	25
	Bronze bearings	Journal bronze	27
	Babbitted bearings	Tin base babbitt	44
	Gland or bushing	Gun metal	25
	Bolts and nuts	Rolled manganese bronze	22
56K	**Rotating Plunger Pumps—**		
	Body or liner and plungers	Gun metal	25
	Shaft	Tobin bronze	23
	Bearings	Journal bronze	27
57L	**Evaporator—**		
	Tubes	Admiralty metal	14
58L	**Distiller—**		
	Tubes	Admiralty metal	14
59L	**Feed Water Heater—**		
	Header	Brazing metal	1
	Tubes	Admiralty metal	14

	Items	Composition	Formula No.
60L	Lubricating Oil Coolers—		
	Tube plates	Rolled commercial brass.	19
	Baffle plates	Rolled commercial brass.	19
61M	Blower—		
	Bearings	Gun metal	25
62N	Tanks, etc.—		
	Tanks	Rolled commercial brass.	19
	Hinges	Hardware brass	4
	Drip pans	Rolled commercial brass.	19
	Funnels	Rolled commercial brass.	19
	Funnel nozzles	Cast commercial brass	9
63P	Boiler Fittings—		
	Safety valve disk	Monel metal	36
	Safety valve, valve seat	Monel metal	36
	Safety valve, valve seat bushing	Gun metal	25
	Safety valve spring case bushing	Gun metal	25
	Safety valve adjusting ring	Gun metal	25
	Safety valve compression screws and nuts	Gun metal	25
	Safety valve bushings in lifting gear	Gun metal	25
	Check valve body	Valve bronze	28
	Check valve disk	Valve bronze	28
	Water gage columns	Screw brass	6
	Gage cocks	Valve bronze	28
	Fusible plugs	Gun metal	25
	Salinometer cocks	Valve bronze	28
64R	Miscellaneous Connections and Fittings—		
	Expansion joint castings	Gun metal	25
	Expansion joint forgings	Rolled naval brass	21
	Cylinder relief valve and seat	Gun metal	25
	Cylinder relief valve cover nuts	Valve bronze	28
	Indicator cocks	Gun metal	25
	Drain cocks	Gun metal	25
	Pipe supports	Screw brass	6
	Wiper for crosshead guides	Rolled commercial brass	19
	Sheet metal oil boxes	Rolled commercial brass	19
	Screw fitted oil cups	Screw brass	6
	Other cast oil or grease boxes or cups	Cast commercial brass	9
	Oil strainers	Cast naval brass	8
	Cast name plates, ullage plates, etc.	Cast commercial brass	9
	Sheet name plates, etc.	Rolled commercial brass.	19
	Studs for indicator gear, revolution counter, etc	Gun metal	25
	Plug cock bodies, plugs and glands	Valve bronze	28
65S	Piping—		
	Pipes	Muntz metal	16
	Thin tubing	Admiralty metal	14
	Brazed flanges	Brazing metal	1
	Screw flanges and fittings	Screw brass	6
66S	Manifolds— (See 67-68-69S)		
67S	High Pressure Superheated Steam Valves—		
	Valve disk and disk nut	Monel metal	36
	Valve seat	Monel metal	36
	Valve stem	Rolled monel metal	36
	Hand wheel	Brass	2
	Gland	Valve Bronze	28
	Gland and bonnet studs and nuts	Rolled naval brass	21
68S	High Pressure Valves— (Except for superheated steam)		
	Body and bonnet, 4 inches and over	Gun metal	25
	Body and bonnet, 3½ inches and less	Valve bronze	28
	Valve disk, 4 inches and over	Gun metal	25
	Valve disk, 3½ inches and less	Valve bronze	28
	Valve disk nut	Valve bronze	28
	Valve seat	Gun metal	25
	Valve stem	Rolled monel metal	36
	Hand wheel	Brass	2
	Gland	Valve bronze	28
	Gland and bonnet studs and nuts	Rolled naval brass	21
69S	Low Pressure Valves—		
	Body and bonnet	Valve bronze	28
	Valve disk and nut	Valve bronze	28
	Valve seat	Valve bronze	28
	Valve stem	Rolled naval brass	21
	Hand wheel	Brass	2
	Gland	Valve bronze	28
	Gland and bonnet studs and nuts	Rolled naval brass	21
70T	Sea Connections—		
	Castings	Valve bronze	28
	Long bolts and inboard studs on wooden vessels	Rolled naval brass	21
	Studs and nuts exposed to sea water	Tobin bronze	23
	Strainer plates	Cast naval brass	8
	Fastenings of strainer plates	Tobin bronze	23
71V	Ash Handling Gear—		
	Ejector nozzle	Cast naval brass	8
72W	Consumable Stores—		
	Babbitt		44
	Round brass bars		19
	Sheet brass		19
	Brazing solder		50
	Soft solder		51

Reduction Gears for Ship Propulsion*

Performance of Single and Double Reduction Gears —Comparison With Other Methods of Propulsion

By Robert Warriner†

DURING the past ten years something like one thousand merchant vessels fitted with geared turbine drive have been built or are building. So rapid has this development been that most of the machinery was designed and built with scant knowledge of the real requirements for sea service and with none of the essential experience which comes from actual practice under continued service conditions. The number of gear cutting machines was also very limited and there was considerable trouble in getting special material. As a consequence there have been some unfortunate experiences which have raised doubts in the minds of many engineers as to the ultimate success of geared turbine drive. On the other hand, there are a number of examples where reduction gears are giving good service and showing better economy than reciprocating engines under the same steam conditions, and there is no doubt that by adopting a conservative design and manufacturing on sound lines this type of machinery can be made more reliable, economical and easier to handle than other kinds of steam machinery.

Lack of knowledge of gears and their requirements on the part of the engine room staff, improper lubrication, failure to keep the oil clean and free of water, especially salt water, are some of the causes of wear and complicate the task of distinguishing between the good and bad of design or material, but this is a condition which is rapidly improving and there are now plenty of engineers experienced in the handling of turbines and gearing.

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Lubricating Systems Standardized

The lubricating oil systems of most of the later boats have been standardized on the lines set forth in a paper by Messrs. Smeltzer and Fernald, read before the Society in November, 1919.

The gravity system insures a constant pressure of oil to all parts of the engine, and the increased capacity of drain and gravity tanks allows for a slower circulation of the oil and provides a reserve supply which will last a few minutes after the pumps stop and allows the turbine to be safely shut down. The settling arrangements are greatly improved and the use of the DeLaval separator will do much to improve the condition of the lubricating oil.

Accuracy in Construction Essential

Accuracy in the cutting of the teeth and machining casings, assembling and setting up of parts is absolutely essential for insurance of good running. The clearance in the bearings must also be uniform so that in whatever direction the pressure is to be taken they will maintain the pinions in a true line with the wheels. The casing should be made as stiff as possible and will be better if it is so designed that

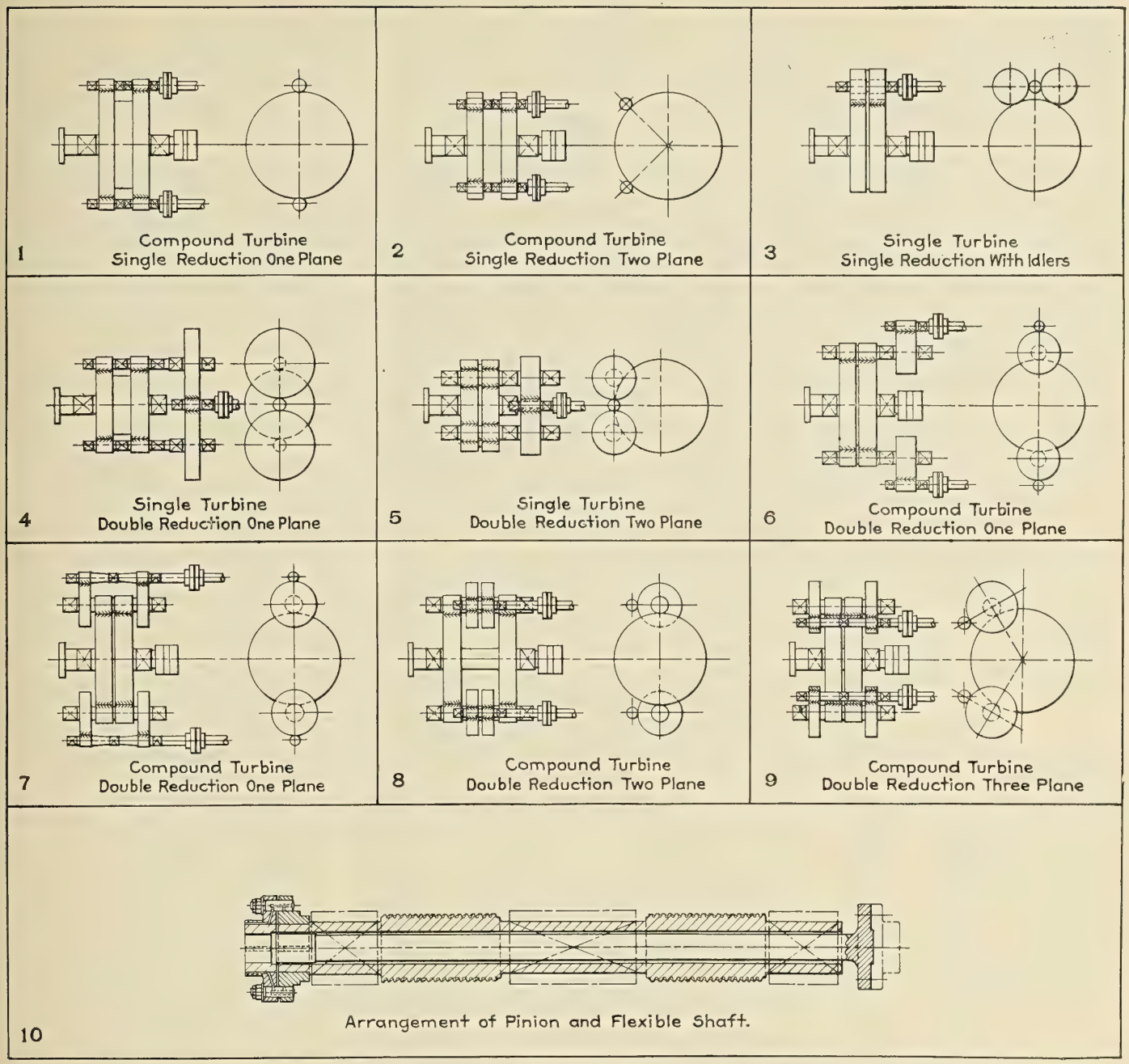


Fig. 1.—Outline Arrangements of Various Gears

it is rigid enough to hold its form when placed on the ship seatings for the process of fitting the packing blocks. The two plane and three plane types are specially advantageous in these respects as the depth is so great as compared with the area covered by the gear. Ship seatings should also be designed so that they will add to the stiffness of the casings. A ship is generally quite flexible and alters considerably with change of trim and works due to the action of the sea. It seems, therefore, desirable to make the seatings so that they will not be influenced by the movements of the ship, that is to say, they shall be substantial structures set down on the ship's bottom and free of all connections to the ship's side or bulkheads which would have the effect of transferring to the gears the movements of the ship. They should be arranged to maintain the alinement of the gears and turbines, and not, as is so often the case, to add strength to the ship's structure.

The maintenance of the contact of the pinions and wheels along the whole face is a matter of one or two thousandths of an inch and unless this alinement is strictly maintained it means that the work has to be done by only a part of the face and that the part which actually does the work is subject to increased pressure.

Undoubtedly some gears have been manufactured with tooth pressures greater than present day materials and manufacture will stand. Devices for giving flexibility and to compensate for misalinement have been tried out in the test house and have shown the capacity of gearing to work under loads far in excess of those used in service. These tests would be carried out under the best conditions with little to distort the casings or to upset the alinement. The conditions at sea, however, are entirely different and it is difficult to estimate what may have to be taken into account. Apart from the alteration in a ship's structure due to loading or trim and running light there is the occasional disturbance due to heavy weather, the effect of which cannot be calculated.

Tables *I* and *II* show the principal dimensions of gears by different makers. These are by no means complete but are representative of what has so far been made. Fig. 1 shows diagrammatically the arrangement of wheels and pinions for a variety of reduction gears and is explanatory of some of the terms used in the paper.

TABLE I.—DOUBLE REDUCTION GEAR DATA

Reduction gear number	1				2				3				4			
Horsepower of ship and number of screws	1,500 Single Screw				2,800 Single Screw				3,100 Single Screw				4,500 Twin Screw			
Horsepower transmitted by each gear	1,500				2,800				3,100				2,250			
Horsepower transmitted by h.p. pinion	1,500				1,400				1,550				2,250			
R. p. m.	3,600-90				3,566-90				3,196-90				3,300-105			
Type of gear	One Plane				Three Plane				Three Plane				One Plane			
Element	High Speed		Low Speed		High Speed		Low Speed		High Speed		Low Speed		High Speed		Low Speed	
Part	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear
Number	1	1	1	1	2	2	2	1	2	2	2	1	1	2	2	1
R. p. m.	3,600	578	578	90	3,566	539	539	90	3,196	538	538	90	3,300	444	444	105
Pitch diameter (D)	85.00"	53.000"	12.400"	79.600"	7.75"	51.250"	15.613"	93.387"	8.500"	50.500"	15.629"	93.371"	7.60"	52.00"	11.274"	17.786"
Number of teeth	34	212	31	199	31	205	31	187	34	202	39	233	40	297	30	127
Diametral pitch	4.0		2.5		4		1.99		4		2.50		5.71		2.66	
Normal diametral pitch	5.65		3.53		5.65		2.16		5.65		2.71		8.02		3.00	
Helix angle	44° 53′ 30″		44° 53′ 30″		44° 53′ 30″		22° 58′ 18″		44° 53′ 30″		22° 58′ 30″		44° 26′		27° 30′	
Pressure angle	26° 56′ 30″		26° 56′ 30″		26° 56′ 30″		20°		26° 56′ 30″		25°		20°		20°	
Effective width of face	15″		36″		14″		26″		16″		27.5″		20″		40″	
Velocity of pitch line per second	133.5		31.2		121		36.7		118.5		36.6		100.9		21.9	
Tangential tooth per lb. per inch of face (P.)	412		733		455		808		450		345		307		706	
K (P_2KV/D)	141		208		163		204		154		214		116		210	
Length of helix per dia. of pinion	1.76		1.45		1.81		.832		1.88		.880		1.03		1.77	
Stress at base of teeth, lbs. per square inch	3,260	2,775	3,780	2,525	3,680	2,500	3,840	2,860	3,565	2,472	4,220	3,160	5,100	4,220	4,400	3,520
Weight per gear in pounds													100,000			
Turbine	Single				Compound				Compound				Single			
Gear maker	Falk Co.				Falk Co.				Falk Co.				Bethlehem Corp.			

TABLE I.—DOUBLE REDUCTION GEAR DATA (CONTINUED)

Reduction gear number	5				6				7				8			
Horsepower of ship and number of screws	2,500 Single Screw				2,400 Single Screw				4,000 Single Screw				3,000 Single Screw			
Horsepower transmitted by each gear	2,500				2,400				4,000				3,000			
Horsepower transmitted by h.p. pinion	2,500				2,400				4,000				1,500			
R. p. m.	3,480-90				3,302-75				3,480-90				3,360-90			
Type of gear	One Plane				Two Plane				One Plane							
Element	High Speed		Low Speed		High Speed		Low Speed		High Speed		Low Speed		High Speed		Low Speed	
Part	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear
Number	1	2	2	1	1	2	2	1	1	2	2	1	2	2	2	1
R. p. m.	3,480	463	463	90	3,302	657	657	75	3,480	458	458	90	3,360	585	585	90
Pitch diameter (D)	7.4"	55.6"	10.25"	52.75"	6.5"	32.667"	11.000"	96.333"	7.612"	57.888"	10.75"	54.75"	5.196"	29.830"	9.238"	60.045"
Number of teeth	37	278	41	211	39	196	33	289	38	289	43	219	27	155	28	182
Diametral pitch	5		4		6		3		5		4		5.2		3.03	
Normal diametral pitch	7.07		4.33		6.73		3.26		6.11		4.35		6		3.5	
Helix angle	45°		23°		27°		22° 58′		35°		23°		30°		30°	
Pressure angle	15°		15°		22° 13′		21° 32′		23° 57′		16° 14′		16° 38′		16° 38′	
Effective width of face	18″		45″		18.4″		32″		19.6″		48″		20″		36″	
Velocity of pitch line per second	112		20.7		93.7		31.6		115.7		21.5		76.2		23.6	
Tangential tooth per lb. per inch of face (P.)	340		740		382		652		486		1,065		541		972	
K (P_2KV/D)	125		231		150		196.5		176		325.5		237		320	
Length of helix per dia. of pinion	2.44		2.20		1.415		1.455		1.29		2.23		1.93		1.95	
Stress at base of teeth, lbs. per square inch	...	...	...	...	4,370	...	3,500	...	4,000	...	6,750	...	10,500	8,300	11,000	8,500
Weight per gear in pounds	75,000				77,000				124,000				63,800			
Turbine	Single				Single				Single				Compound			
Gear maker	De Laval Co.				General Electric Co.				General Electric Co.				Westinghouse Co.			

TABLE II.—SINGLE REDUCTION GEAR DATA

Reduction gear number	9		10		11		12		13		14			15		16	
Horsepower of ship and number of screws	9,000 Twin Screw		5,000 Twin Screw		4,500 Twin Screw		10,000 Twin Screw		12,000 Twin Screw		28,000 Twin Screw			90,000 Quadruple Screw		27,000 Twin Screw	
Horsepower transmitted by each gear	4,500		2,500		2,250		5,000		6,000		14,000			22,500		13,500	
Horsepower transmitted by h.p. pinion	2,250		1,250		1,125		2,500		3,000		7,000			11,250		6,750	
R. p. m.	1,500-120		2,204-110		1,924-105		1,793-125		1,789-125		3,217 and 2,994-450			2,513-400		2,950-455	
Type of gear	One Plane		One Plane		Two Plane		One Plane		One Plane		One Plane			One Plane		.....	
											H. S.	I. S.					
Part	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Gear	Pinion	Pinion	Gear	Pinion	Gear	Pinion	Gear
Number	2	1	2	1	2	1	2	1	2	1	1	1	1	2	1	2	1
Pitch Diameter (D)	8.50"	106.75"	6.000"	120.240"	7.143"	130.857"	9.143"	131.143"	10.0"	143.143"	10.800"	11.600"	77.200"	13.429"	84.286"	10.227"	66.314"
Number of teeth	34	427	25	501	25	458	32	459	35	501	27	29	193	47	295	31	201
Diametral pitch	4		4.167		3.5		3.5		3.5			2.5		3.5		3.03	
Normal diametral pitch	5.65		5.00		4.04		4.95		4.95			3.54		4.04		3.5	
Helix angle	45°		33° 33′ 26″		30° 2′ 54″		44° 53′ 30″		44° 53′ 30″			44° 53′ 30″		30° 2′ 54″		30°	
Pressure angle	15°		20°		25°		26° 56′ 30″		26° 56′ 30″			25°		25°		16° 38′	
Effective width of face	48″		24″		22″		36″		38″			33″		48″		26″	
Velocity of pitch line per second	55.5		57.8		60.0		71.7		78.2			151.5		147.2		131.5	
Tangential tooth per lb. per inch of face (P.)	463		496		469		532		555			770		877		1,080	
K (P_2KV/D)	159		202		175		176		175		234	226		239		328	
Length of helix per dia. of pinion	2.83		2.00		1.54		1.97		1.90		1.53	1.42		1.79		1.27	
Stress at base of teeth, lbs. per square inch			5,630	3,960	3,960	2,770	3,610	2,555	3,780	2,660	6,010	5,920	4,125	4,300	3,855	11,750	9,100
Weight per gear in pounds	76,000		60,000		.....		.....		.....			38,400		.....		21,200	
Turbine	Compound		Compound		Compound		Compound		Compound			Compound		Compound		Compound	
Gear maker	De Laval Co.		Bethlehem Corp.		Falk Co.		Falk Co.		Falk Co.			Falk Co.		Falk Co.		Westingh'se Co.	

Few Failures with Single Reduction Gears

The single reduction sets are generally satisfactory and out of the large number fitted there have been very few failures. The tooth pressures are not excessive, those for war vessels may be fairly high but they have only to work at full power occasionally and for very short periods. The turbine speeds are usually moderate and the inertia of the

moving parts correspondingly low. It is easy to estimate the load on each pinion due to the turbine and the difference between mean and maximum torque is much smaller than in the case of double reductions with their high speed turbines. In the latter (Nos. 4 and 5, Fig. 1) where a single turbine is used to drive two sets of wheels and pinions, it is difficult to assemble them so that work is divided evenly between the two sets, and any uneven wear or adjustment of the bearings will throw most of the load on one side or the other with an increase of the tooth pressure on that side.

Some of these gears are also solidly coupled together so that there is no give in the gears themselves to compensate for this uneven loading.

The single reduction gears under column No. 9 of Table II have given considerable service. They were installed on the *Orizaba* and *Sibboney* and were manufactured by the DeLaval Company. Both of these vessels were operated under very severe overload conditions during the war. The *Orizaba* has steamed, to date, over 225,000 miles and the *Sibboney* 175,000 miles. It is stated that when the gears were last examined they were in excellent condition. All the other gears of this sort, tabulated, are, so far as can be learned, operating well, though the mileage is much less than in the case of the two ships quoted.

Among the double reduction gears there are some cases of extended running which point to the loads which gearing will stand safely. The S. S. *Pacific* in service since December, 1915, still has the original low speed gears, which, on last report, had made 240,000 miles. The S. S. *Sucrosa* in service since July, 1916, also has the original low speed gears after running 225,000 miles. The high speed train was renewed after 120,000 miles. The S. S. *Mielero* had the original gears still in use after three years' running during which she made 160,000 miles. These are all of the two plane type (No. 5, Fig. 1) and were made by the General Electric Company.

The design tabulated in column 1, Table I, has given an excellent account of itself and there have been no breakdowns or repairs. Some of these units have been in service over two years and show little sign of wear. Those tabulated under column 3, Table I, have also given excellent service. Both of these are Falk gears.

In regard to double reduction gears of the single plane type the results are various but there are few which have seen 100,000 miles of sea service, and this type is not likely to be repeated, to any great extent.

Maximum Safe Tooth Pressures

After studying the results obtained on various types the author suggests the following table of tooth pressures as being the maximum which it is safe to use:

$$K = \frac{P}{\sqrt{D}}$$

P = Pressure per inch of working face
D = Diameter of pinion in inches

		K	D
Double reduction gear with a single turbine where a single pinion meshes with two high speed wheels coupled to two low speed pinions driving one low speed wheel	High speed	120	6″ to 9″
	Low speed	180	9″ to 16″
Double reduction gear, single or compound, where each turbine drives a single wheel and pinion	High speed	150	6″ to 9″
	Low speed	220	9″ to 16″
Single reduction gears, constant service		175	
Single reduction gears where full power is only used occasionally		250	

One further important item is the length of helix in proportion to the diameter of the pinion, and the constants quoted are based on the assumption that this ratio does not exceed 2 to 1 and should be reduced to 1.5 to 1 whenever possible.

Considerable difference has been found in the life of gears of the same design, between those fitted amidships and those fitted in the stern of the ship, the latter wearing more rapidly. The inertia of the turbine is much greater than that of the propeller and shafting and the turbine will run with practically uniform angular velocity while the motion of the propeller will be uneven due to the different conditions of water, depths, etc. This variation will have little effect on the gears when transferred through the long flexible shaft of the machinery fitted amidships, but with the short shaft for those fitted in the stern of the vessel this variation of torque will be reflected on the teeth without any damping due to the shaft. When reduction machinery is fitted in the after end of the ship it is better to fit the turbines aft of the gears so as to make the line shaft as long as possible.

High Degree Superheat Would Increase Efficiency

The superheater has, so far, not found much favor in America for marine purposes, and considering the number of turbine driven vessels that are being built it is surprising that so many are working without superheat. The turbine under the same steam conditions gives an efficiency of 10 to 15 percent better than the reciprocating engine. From the actual service results of three steamers of the same capacity and in the same trade and running 55,000 miles a year, the one with triple expansion engines used 335.3 pounds of oil per knot and the other two with turbine machinery used 281.5 pounds and 282.5 pounds of oil, respectively. This could have been improved considerably by the use of superheat with very little increase in the cost of the turbines. Practically all that would have been needed would be to make the high pressure end of the casing of cast steel instead of cast iron.

Table III

	Reciprocating	Turbine	Diesel	Electric Drive
Speed of ship, knots	11.5	11.5	11.5	11.5
Diameter of propellers	17′ 6″	15′ 8″	15′ 8″	15′ 8″
Revolutions per minute	76	105	105	105
S. H. P. for 250 sea miles per day	4135	4350	4350	4350
S. H. P. maximum	4600	5800	5000	5800
Weight of machinery and water, tons	1060	914	1267	981
Weight of machinery in lbs. per max. S. H. P.	517	353	567	379
Space occupied by machinery, cubic feet	171,826	171,826	192,251	171,826
Total weight of hull and machinery, tons	9350	9200	9700	9267
Net carrying capacity of ship bunkered for 20 days' steaming and 8 days' reserve fuel, tons	18,775	19,220	19,482	19,153
Comparative cost of machinery	100	98.3	123.5	128.3
Fuel consumption per day 250 sea miles, tons	60	48	24	48
Estimated cost of operating per day*				
Crew	13.33	13.33	14.46	13.33
Repairs	11.34	11.34	11.34	11.34
Stores	4.82	4.82	7.89	4.82
Provisions	3.97	3.97	4.26	3.97
Depreciation	27.10	27.00	29.83	30.10
Insurance	17.60	17.53	19.40	19.67
General	1.42	1.42	1.42	1.42
Fuel oil	20.42	16.34	8.18	16.34
Total	100.00	95.74	96.38	100.99
Per deadweight ton	100.00	95.74	96.38	100.99

* Based on total of 100 for reciprocating machinery.

There is shown in Table III a comparison of machinery for 20,000 deadweight tons combined ore and oil vessels, showing the relation as to the weight, space, cost and operating expense for reciprocating engines, turbines and reduction gears, Diesel and electric drive on these particular vessels. In this the Diesel engine is rather at a disadvantage owing to the necessity of fitting considerable boiler power for heating the cargo oil. All the sets are twin screw.

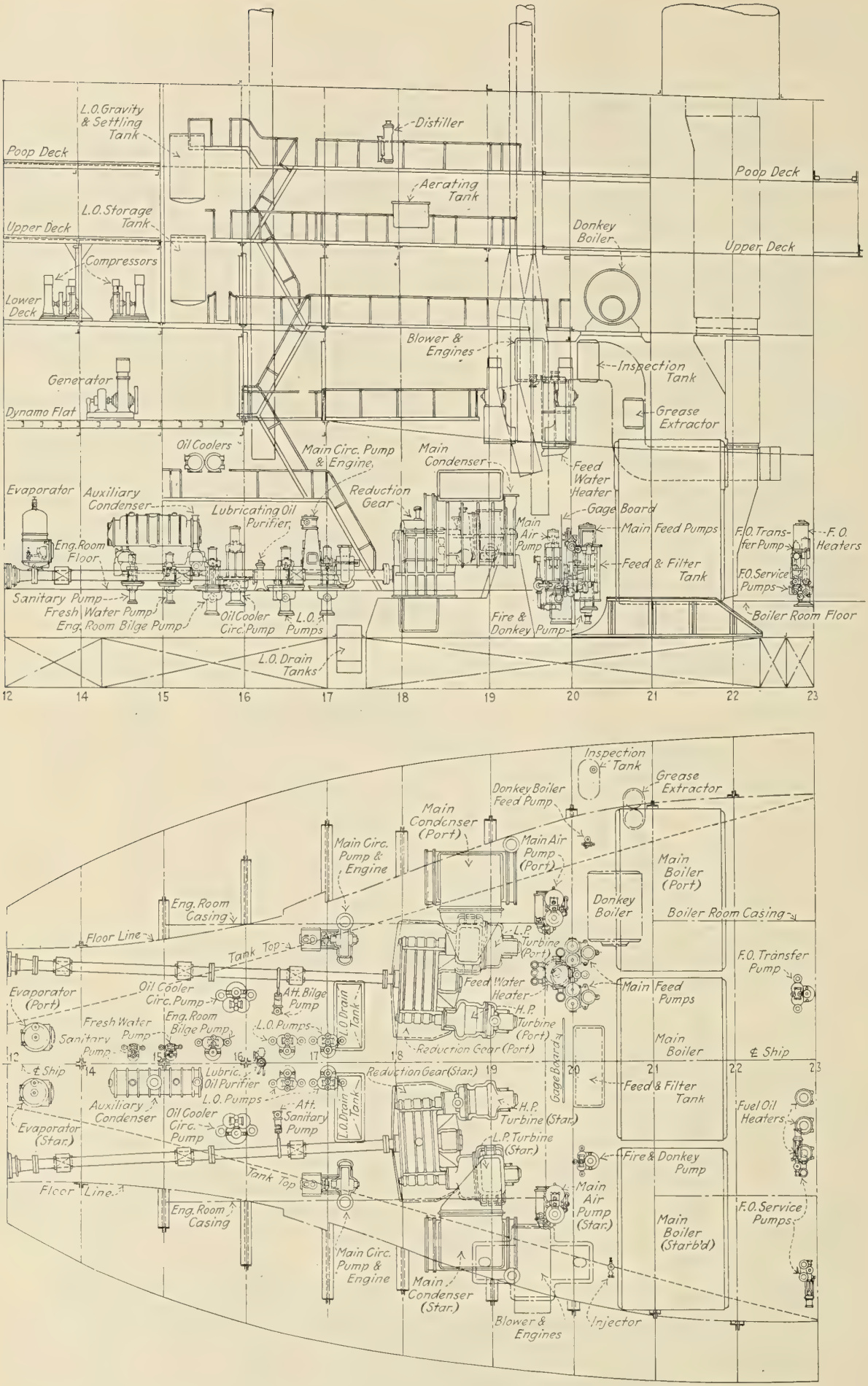


Fig. 2.—Arrangement of Twin Screw Geared Turbine Machinery of 5,000 Shaft Horsepower

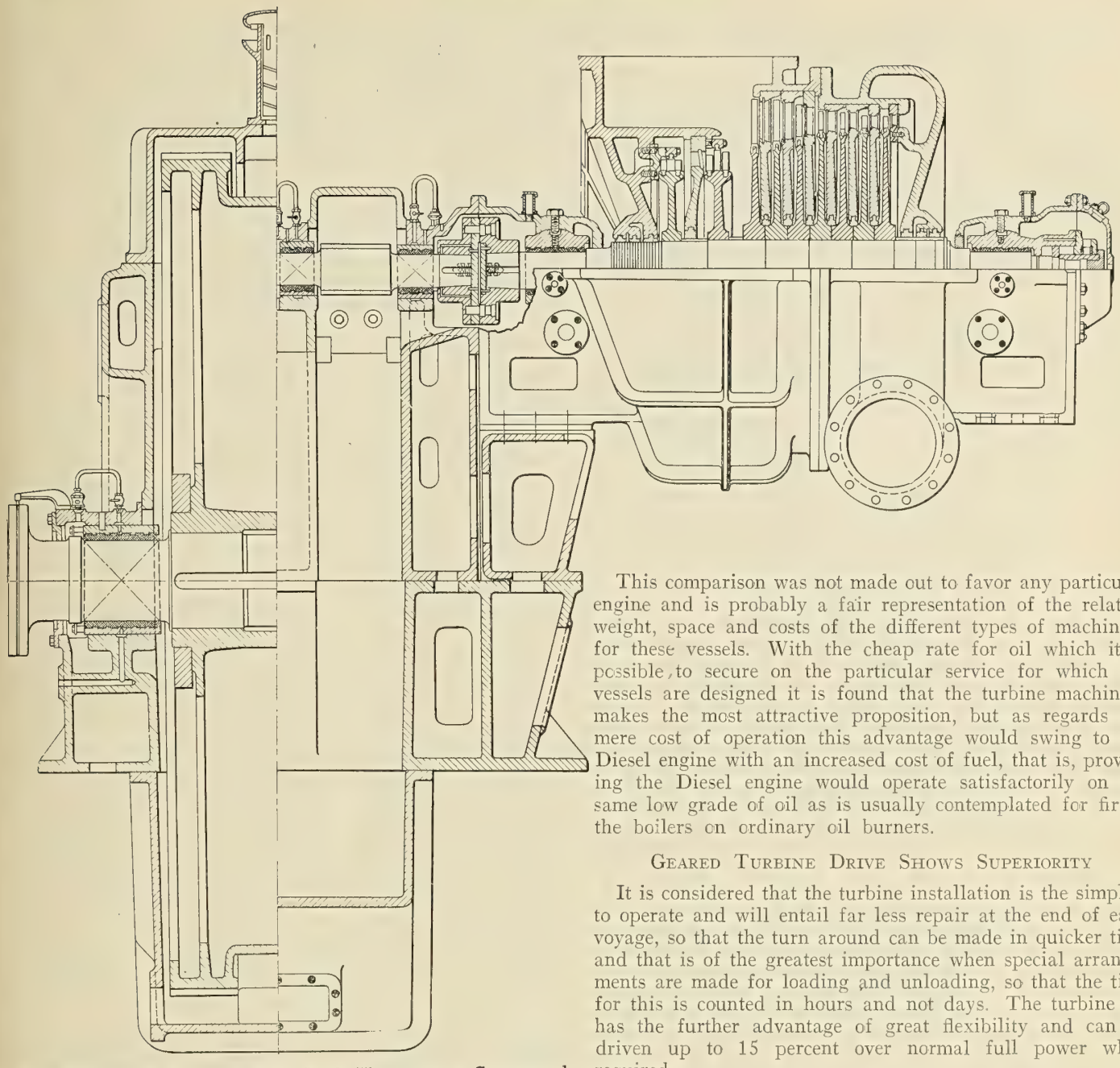


Fig. 3.—Section Through 2,500 Shaft Horsepower Compound Curtis Turbine and Falk Single Reduction Gears

The reciprocating engines are triple expansion with cylinders 25 inches, 41 inches and 68 inches diameter by 48 inches stroke and there are three cylindrical boilers 17 feet 6 inches diameter by 12 feet long, operated at 190 pounds per square inch and 20 degrees superheat, oil fired and with heated air forced draft.

The turbine machinery is cross compound with single reduction gears, turbine revolutions 1,930 per minute to 105 at the propellers. The boilers are the same size as for the reciprocating set and arranged for 220 pounds per square inch working pressure and 200 degrees F. superheat. The water rate for the turbines will be 9.6 pounds per shaft horsepower per hour.

The Diesel machinery consists of two engines, each with six cylinders 25½ inches diameter by 48-inch stroke, two cycle. In this ship all the main and auxiliary deck machinery is driven electrically.

The electric drive consists of one turbo-generator with an auxiliary generator to give a speed of about six knots, and two large motors, one on each propeller shaft. The boilers are the same as for the turbine drive.

This comparison was not made out to favor any particular engine and is probably a fair representation of the relative weight, space and costs of the different types of machinery for these vessels. With the cheap rate for oil which it is possible to secure on the particular service for which the vessels are designed it is found that the turbine machinery makes the most attractive proposition, but as regards the mere cost of operation this advantage would swing to the Diesel engine with an increased cost of fuel, that is, providing the Diesel engine would operate satisfactorily on the same low grade of oil as is usually contemplated for firing the boilers on ordinary oil burners.

GEARED TURBINE DRIVE SHOWS SUPERIORITY

It is considered that the turbine installation is the simplest to operate and will entail far less repair at the end of each voyage, so that the turn around can be made in quicker time and that is of the greatest importance when special arrangements are made for loading and unloading, so that the time for this is counted in hours and not days. The turbine set has the further advantage of great flexibility and can be driven up to 15 percent over normal full power when required.

It is interesting to note that the cost of the turbine installation is somewhat less than that of the reciprocating machinery, and if the boilers had been reduced to the extent warranted by the decreased steam consumption of the turbine, there would have been a still further reduction in weight and cost. It was, however, considered to be an advantage to have the boilers operating under easier conditions for the normal full power and to have available, when required, the extra power and speed.

The arrangement of the turbine machinery is shown on Fig. 2 and of the turbine and gears on Fig. 3.

When comparing the efficiency of turbines and reciprocating engines it is usual to consider the best steam consumption of both. The turbine having good clearances and no wear on the parts affecting economy should maintain its efficiency, but the reciprocating engine falls off rapidly, due to the wear on valves and piston rings, liners and cylinders.

The question of gear efficiency has been much debated and various factors have been given from time to time. The Falk Company devised a means of testing them under full load, for bearings and teeth, with a motor large enough to supply the amount lost in friction only. This was further extended so that they could be tested for efficiency and tests

were subsequently made on a number of gears, the results of which the Falk Company have kindly allowed me to add to this paper.

TESTS FOR EFFICIENCY OF GEARS

The first of these was on two sets of single reduction gears for one of the 35-knot destroyers built by the Bethlehem Shipbuilding Corporation at Fore River. The two gears, port and starboard, are placed back to back with a space of 10 or 12 feet between them. The main shafts and pinions are coupled together, the latter by means of torsion shafts with large couplings so that the twist on the shaft can be varied at will. By this means it is possible to put the same load

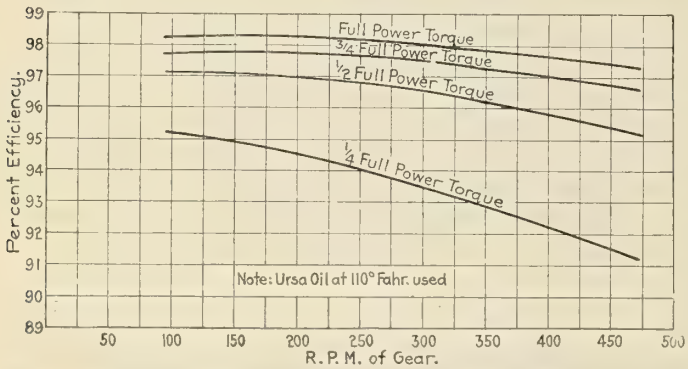

Full Power Torque
3/4 Full Power Torque
1/2 Full Power Torque
1/4 Full Power Torque
Note: Ursa Oil at 110° Fahr. used
Percent Efficiency.
R. P. M. of Gear.

Fig. 4.—Efficiency Curves from Tests on 14,000 Shaft Horsepower Geared Unit

on the bearings and to run the gears at the same tooth pressures and under the same conditions as when operating on board ship. The two sets are driven by a direct current motor at the required speed and the power developed by the motor represents the friction of all the gears and bearings in the two units. The thrusts are not loaded but these are not a part of the gears and as they are only located in the casing for convenience of manufacture they should not be included in the gear losses. The results are corrected for motor effi-

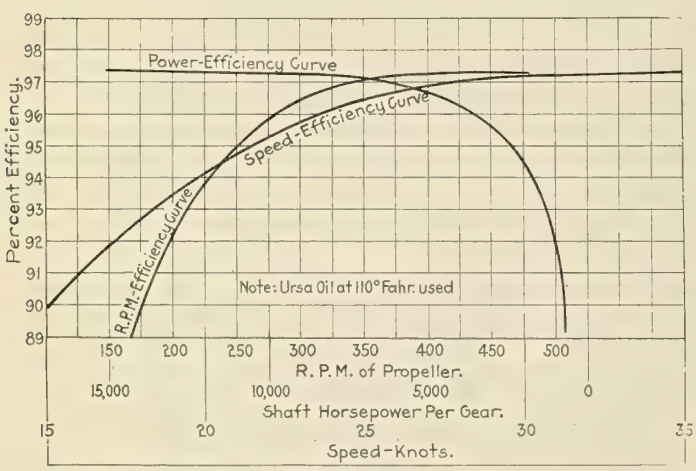


Fig. 5.—Efficiency Against Actual Speed Characteristics of Ship

ciency. The oil service and lubrication are the same as for actual service.

In the case of the destroyer gears a number of tests were run with various loads and speeds so as to obtain a curve for the efficiency over a range of speeds and powers. The curves for the actual tests are shown for one-quarter, one-half, three-quarters and full power torque, each over a range of speeds (see Fig. 4) and from these further curves have been developed showing the efficiency at various speeds, powers and revolutions at which the machinery would work in the ship, Fig. 5. It will be seen that the maximum efficiency is 98.3 percent at full torque and about one-half speed. In a ship, however, this condition is not used and the maximum efficiency is only 97.3 percent. The bearings of these sets are very ample and account for the major part of the friction loss. Further experiments were made with shortened bearings and showed a gain in efficiency, but the curves are given for the actual gears as installed.

A summary of other tests is contained in Table IV.

TABLE IV.—RESULTS OF REDUCTION GEAR TESTS

Test No.	2	3	4	5
Duration of test	21 hrs.	14 hrs.	11 days	8 hrs.
Total horsepower output of two gear units	12000	12000	6000	6200
Horsepower delivered by each pinion	3000	3000	1500	1550
Tooth pressure, lbs. per in. of face—H. S.	630	553	482	448
Tooth pressure, lbs. per in. of face—L. S.	....	....	862	842
Inlet temperature of water to oil cooler, deg. F.	67.0	59.5	51.7	54.0
Outlet temperature of water from oil cooler, deg. F.	82.2	75.1	72.4	67.9
Pounds of water per min. to cooler	424	442	312	386
Horsepower absorbed by cooling water	152	168	151	126
Temperature of oil to unit, deg. F.	125	110.5	103	118.5
Temperature of oil from unit, deg. F.	131	120.5	....	124
Pressure of oil to gears	18.4	8.9	12.0	11.7
Revolutions per min. of propeller shaft	125	125	90	90
Horsepower loss in units	229	209	203	186
Output plus losses of gear units	12229	12209	6203	6386
Gear unit efficiency	.981	.983	.968	.973

Test No. 2 was made on units of single reduction gears for the passenger ships for the United States Shipping Board. These units were designed for a normal horsepower of 10,000 but the test was made at 12,000 shaft horsepower as shown with a gear efficiency of 98.1 percent.

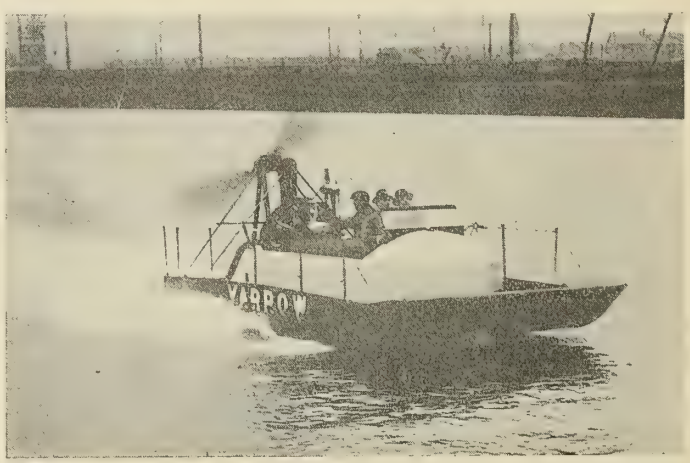
No. 3 was made on units for passenger ships similar to No. 2, but designed for 12,000 shaft horsepower. These were made at a later date and the improvement is shown by the increased efficiency.

The fourth test was made on a pair of double reduction gears with compound turbines and was carried on continuously for eleven days. The conditions were maintained very nearly constant and the efficiency, 96.8 percent, is very good for this type of machine.

Column No. 5 is for a similar set of gears with improved bearings, an arrangement which resulted in increasing the efficiency to 97.3 percent.

A New Type of Shallow Draft Vessel

CONSIDERABLE interest is being shown in the skimming boat which Messrs. Yarrow & Company, of Glasgow, Scotland, are running on the Clyde, both river and firth, and which is propelled by an aeroplane type petrol engine and air propeller. The hull is of the hydroplane type.



The Yarrow Skimming Boat at a Speed of 50 Miles Per Hour

Superheated Steam on Steamships

Comparison with Locomotive and Shore Practice—Results with Reciprocating Engines and Scotch Boilers

By C. H. Peabody, Dr. Eng.

THE advantages of the use of superheated steam have long been known in America and in particular as applied on steamers. In 1863 Chief Engineer B. F. Isherwood, U. S. N., made exhaustive tests on the U. S. S. *Eutaw* and put the whole matter on a scientific basis pointing out the precautions that must be taken to insure reliable results and the proper way of reporting gains in terms of coal used per horsepower per hour. Those were the days of simple engines, small powers and low pressures. Any proper method of saving fuel was bound to give notable results; his experiments showed a gain of eighteen percent from the use of superheated steam.

Following Isherwood's investigations, superheated steam was used in both the American and the British navies with decided advantage so long as the superheaters were in condition. The last sentence gives half the answer to the question why superheating, having repeatedly shown notable advantage in economy, nevertheless has fallen into disuse and under prejudice with some engineers; the other half of the answer is that in the earlier days of steam engineering other methods of improving economy found favor, such as compounding and steam jacketing.

Again and again, superheating has fallen into disfavor because the superheater has burned out and leaked. In later years greater knowledge of metallurgy and new methods of construction have met this difficulty so that today superheaters showing long and satisfactory service are found on shipboard, in the British, French and German merchant marines. Now that the United States is striving for its place in the ocean carrying trade it is necessary that intelligent attention should be given to the use of superheated steam.

It is notable that superheated steam finds favor today in America at the extremes; with the most economical and with the most wasteful of steam motors; namely, for steam turbines and for locomotive engines.

Superheated Steam on Locomotives

The use of superheated steam on locomotives is particularly interesting for our present purpose, because the locomotive has some of the restrictions of the marine engine in an exaggerated form and because the form of superheater which has given satisfaction on the locomotive is now widely used for ships. It will be recalled that about twenty-five years ago compound locomotives were introduced and found considerable favor. Two reasons led to this, first a desire to save coal and second to get more work out of a given locomotive boiler; and the second was the controlling motive. Coal may cost money, but in any case the train must be taken over the road. And trains continually grow heavier.

The attitude of the railway man is shown by the tests made of superheating by the Pennsylvania railroad. They selected the summer train from Camden, N. J., to Atlantic City. Using the old type of locomotive with saturated steam they began with a train of seven cars to determine the maximum weight of train that could make the run on time. One by one cars were added till there were ten in the train and still the locomotive could make the run on time. One more car, making eleven in all, was just too much and the locomotive failed to make time. Taking the same engine with a superheater added they began with eight cars and, as before, added one car after another until there were fourteen cars on the train and yet the locomotive could make the run on time. Fifteen cars were found to be too many; thus the comparison showed that the superheater had an advantage in the ratio of 14 to 10. Incidentally the locomotive with superheater burned a little less coal when dragging 14 cars than the other engine dragging 10 cars.

It should be remembered that the locomotive has a single unjacketed non-condensing engine and with a moderate ratio of expansion. Such an engine has but a poor economy due in large measure to cylinder condensation. Superheated steam acts directly and effectively to reduce cylinder condensation and superheating of itself tends toward better economy. But there is on the locomotive another and a most important advantage from the use of the superheater in that it adds heating surface which the locomotive sadly needs, and again the gases from the boilers are so hot that they can do the superheating without calling for more coal.

It is therefore no wonder, now that a practical superheater is found, that at the present moment half the locomotives in the United States have superheaters. It is to be expected that, in the near future, practically all locomotives will be provided with superheaters.

Let us pause to consider why the compound locomotive after having won a favorable place has so far lost it that but few are found in service and fewer are likely to be built. The first and controlling reason is that a locomotive must be simple and certain in action and must be able to pick up its train smoothly and quickly. The locomotive engineers did not like the compound type and in this case we must admit that the practical man had reason for his prejudice.

Superheated Steam in Power Plants Ashore

Having considered one extreme of our subject, namely, the locomotive, let us take the other, that is to say the steam turbine as used in a modern electric power station. Here every means of improving economy may be found. The boiler has ample heating surface and the hot gases are passed through an economizer so that they may have only enough temperature left to work the chimney. Under such condition, as pointed out by Isherwood, fuel must be burned to superheat the steam; and under just such conditions the turbine engineer claims that the advantage of superheating is more than thermodynamics would indicate. The turbine engineer has found that superheating reduces the blade resistance of the turbine and so indirectly as well as directly adds to the economy. This is worth consideration now that turbine propulsion bulks so large in marine engineering.

But the question is now the application of superheating to the reciprocating marine engine. Though the concentration of power on shipboard long ago outstripped land power stations and though the economy of coal has always been of vital importance, the marine engine never has been in the same class with high class land engines like those at pumping stations. There are two controlling reasons for this defect; the boilers must avoid undue weight and the engines must be simple mechanically and certain in action. The boilers never have as much heating surface as the engineer would like and the valve gears are directly moved by link motions. Even though triple expansion engines are habitual for seagoing ships the expansion is insufficient and there is little gain from high vacuua. Large engines are commonly fitted with cylinder liners and the jackets on the

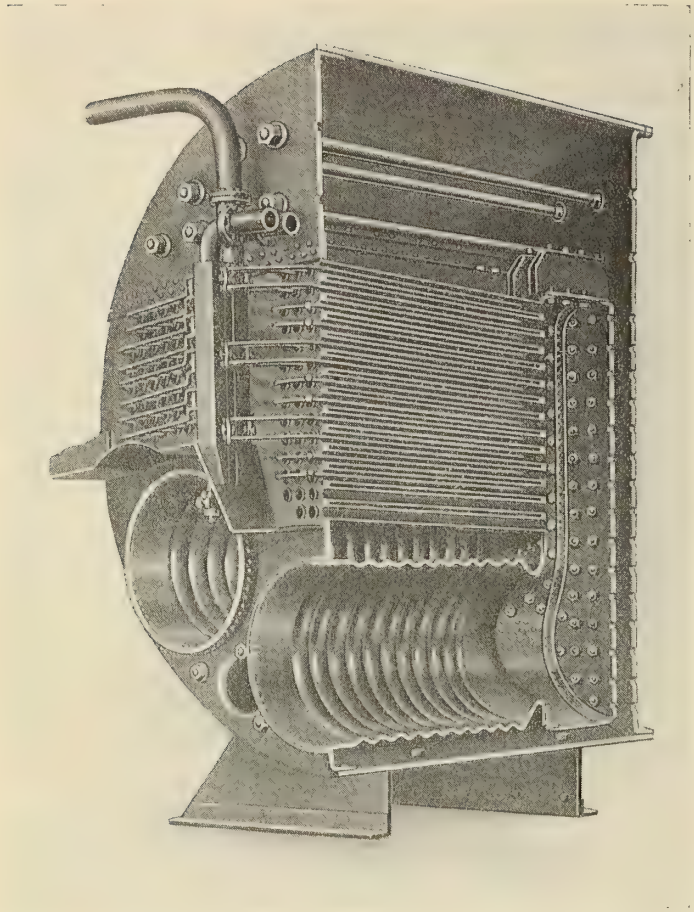


Fig. 1.—Sectional View of Scotch Boiler, Showing Location of Superheater Elements in Fire Tubes

barrels are used for warming up the engine, but too often are either shut off or ineffective at sea. The marine engine, though subject to its limitations, is in much better care than the locomotive engine and the gain from superheating cannot be expected to be so large; but under some cases the gain may be very important and the subject is worthy of consideration for all ships.

Having opened the subject, this article will be limited to describing one type of superheater and the presentation of one clear case of the advantage from superheating.

Superheaters for Scotch Boilers

The form of superheater here presented is that made by the Superheater Company, New York, and adapted to use with Scotch boilers; this form of superheater is interesting because of its extensive use on locomotives where conditions are at least as strenuous as on any steamship.

The application of this type of superheater to a Scotch boiler with three furnaces is shown by Figs. 1 and 2. The steam pipe leading from the dry pipe (Figs. 1 and 2) is shown entering the uptake at the left of Fig. 1; the main then branches inside the uptake and connects with the saturated steam headers as shown more clearly in Fig. 2. From the saturated header a superheater unit or units are carried for each horizontal row of fire tubes of a wing furnace; the middle furnace is supplied alternately from one header or the other. The unit, which is a continuous flat coil of pipe, after serving the several tubes in its row is connected to the superheated header as shown in Fig. 2. From the superheated headers, pipes lead out of the uptake and to the steam main. Certain rows of the boiler fire-tubes are left vacant as a matter of convenience.

The superheating units are made by forging the ends of a straight section into a return bend, whose thickness is somewhat greater than the thickness of the tube, as shown by Fig. 3. By this form of construction each unit consists of a single continuous pipe without screwed joints or connections.

Each unit is connected to the saturated header at one end of the flat coil, and to the superheated header at the other end, by a recessed joint shown in Fig. 4. The collar on the unit pipe is expanded and recessed, and by means of an open end clamp engaging two unit ends, is held in

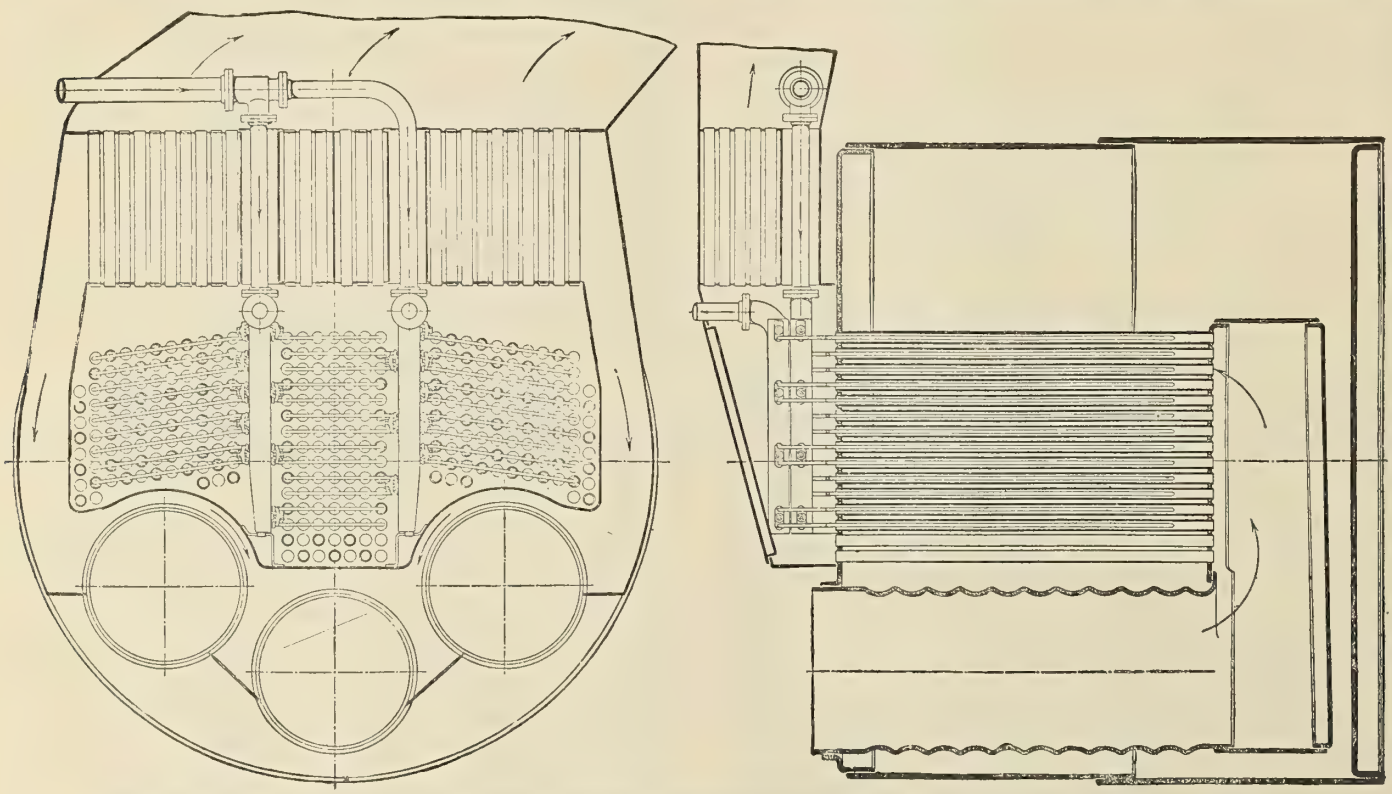


Fig. 2.—Fire Tube Superheater in Scotch Boiler Showing Steam Piping to and from the Superheater as Well as Air Preheater Located in the Uptake

place. One stud holds one clamp. A gasket of metal and asbestos forms the joint between the collar and the recessed seat of the header. Any unit can be removed without disturbing other units, or necessitating dismantling any part of the boiler. The headers are made of either steel, or semi-steel, and meet the requirements of all classification societies.

Engine Valves and Fittings for Superheated Steam

An engine using superheated steam should have piston valves; at any rate the high pressure valve must be a piston valve. Suitable metallic packing must be used on the high pressure piston rod and valve stem. Also a proper high flash mineral oil must be used for cylinder lubrication. Proper oil for this purpose can readily be obtained on the market.

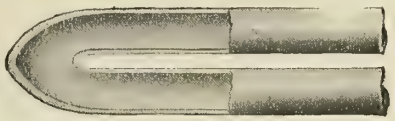


Fig. 3.—Sectional View of Continuous Return Bend of Superheater Element

The cleaning of both the superheater units and of the boiler firetubes is done effectively by aid of superheated steam jets provided for the purpose.

When superheated steam is used the pipe lines and fittings should be of steel and cast steel respectively. Copper and bronze lose strength when subjected to the high temperature of superheated steam.

For equal engine power the cut-off for the high pressure cylinder should be somewhat increased; this usually can be done by adjusting the valve gear. It is recommended that for new construction the high pressure cylinder be made somewhat larger.

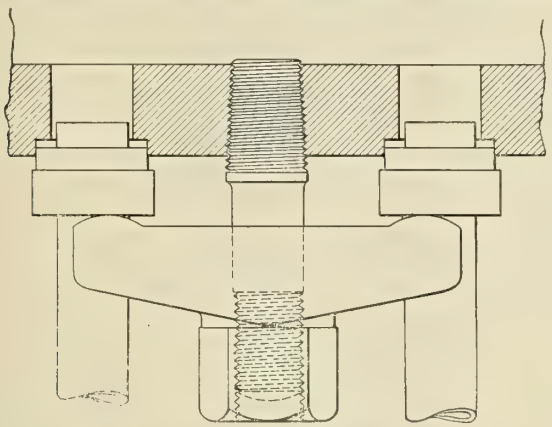


Fig. 4.—Superheater Pipe Joint

The Superheater Company reports over 2,000 ships which use their type of superheater. Among these there are vessels of the following nationalities: United States, Great Britain, France, Japan, Italy, Norway, Portugal and Holland. The horsepower of the various ships ranges from 400 to 20,000.

COMPARATIVE PERFORMANCES, SATURATED AND SUPERHEATED STEAM, OF LEHIGH VALLEY R. R. COMPANY'S TUGS IN TOWING SERVICE

	Lehigh		Perth Amboy	
	Sat.	Super.	Sat.	Super.
Duration of tests, hrs	46.92	85.5	47.58	54
Total tons of tow	3,451	5,149	3,322	3,502
Boiler pressure, pounds	173	173	186	187.5
Vacuum, inches	23.5	23.4	24.3	24.8
R. P. M.	87.7	92.3	93	94.8
I. H. P.	633	803	775	887
Temperature at throttle, F.	376	575	382	590
Temperature feed water, F.	233	230	222	224
B. T. U. per pound of coal	12,758	11,166	12,483	12,423
Coal per sq. ft. grate per hour, pounds	16.15	16.85	18.6	18.1
Coal per I. H. P. hour, pounds	2.29	1.90	2.61	2.22
Fuel economy	....	17%	....	15%
Displacement, tons	446	446	452	452

Comparative Test Data

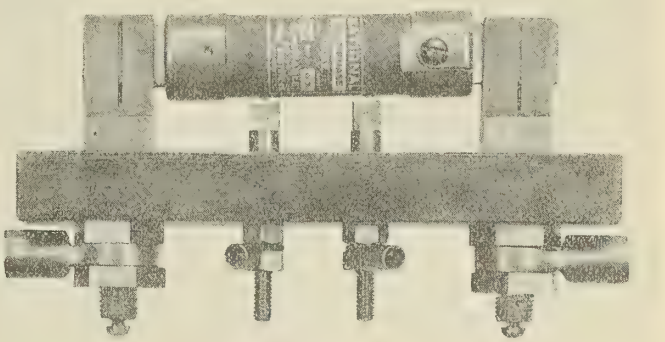
As a specific case tests are here quoted, which were made on two tow boats belonging to the Lehigh Valley Railroad Company. Both were of the same type and nearly the same size and power. Each had triple expansion engines without steam jackets. Each had a single Scotch boiler having four furnaces using anthracite coal.

These tests show a clear gain of 17 percent in one case and of 15 percent in the other computed in pounds of coal, not allowing for variation in heating power of the fuel; were an allowance for the heating power to be made the former figure would be considerably greater. For both boats a larger power was developed with superheated steam; for tow boats a larger power may be as valuable as the saving in fuel, but for steamers in general such a statement cannot be made.

The Superheater Company presents evidence that certain steamers in regular service use from 1.2 to 1.4 pounds of coal per indicated horsepower per hour for all purposes. It may be possible in a later article to present and analyze reports from the use of superheated steam on such ships.

Renewable Fuses for Multiphase Motors

WHEN it was found that the relay system in connection with the control apparatus of multiphase motors could not be designed to prevent these motors from running single phase, the Federal Electric Company, of Chicago, developed a low voltage auxiliary coil as a part of their renewable cartridge fuses, which accomplishes the desired result. The new device, known as the "National" multiphase renewable fuse, serves two purposes: as a fuse it is so constructed that it withstands the high starting current of motors and also protects the running load within the limits prescribed by the Underwriters' Laboratories, Inc. It is of the powder packed type and has a metallic indicator which shows in plain view upon the outside of the fuse the rated amperage of the element with which the fuse is loaded. As the fuse is made for operation on a multiphase circuit, it acts as a circuit breaker; that is, when one fuse blows, the auxiliary coil in the fuse makes one of the elements in another fuse blow, thereby breaking the circuit entirely and eliminating the possibility of the motor running single phase. This action really has the effect of a time limit fuse. Only one element can be placed in the renewable fuse, so there is no danger of interruption of motor service or the necessity of rewinding motors which might be caused by overloading the fuses if two or more elements or a single element of too great capacity were placed in the fuse case.



Multiphase Time Limit Renewable Cartridge, Showing Back Connected

Internal Combustion Engines Applied to Propulsion*

Comparative Earning Capacities of Motorships and Oil Burning Steamers — Machinery Equipment of Motorship William Penn

By John F. Metten and J. C. Shaw

AS with the steam engine, there is a limit in size of cylinder for a Diesel engine, and it would appear that a 31½-inch diameter is nearing this limit, due principally to liner thickness required. Considerations of convenience for handling the parts on board ship are also involved. It would seem that the next logical step with the four cycle engine for increasing the power to more than 500 indicated horsepower per cylinder is to resort to the double acting piston. From the standpoint of elimination of heat troubles, the condition is believed to be more favorable for the double acting four cycle engine than for the single acting two cycle engine, as the maximum temperature at the first part of the power strokes is alternately distributed to the two ends instead of continually to one end of the cylinder as with the two cycle.

Electrically Driven Auxiliaries

The adaptability of the motorship in having its auxiliaries electrically driven and the advantages resulting from the same were at the beginning recognized by Burmeister & Wain and incorporated in their first vessel. As the internal combustion engine by nature requires an external source of power for starting and maneuvering, the same power can be effectively used for other purposes as for driving pumps in engine room and deck machinery. The saving in fuel thus made, being about one-tenth that of a steam vessel when in port it should be observed, is due primarily to the efficiency of the Diesel engine driving generators and not so much to the electrical transmission as some have been led to assume.

In the earlier installations two large auxiliary engines were used, each driving a generator and compressor in tandem, the latter being uncoupled when in port. This was soon replaced by three, and now, as in some of the larger vessels, by four, small sets having generators only. The compressors on the main engines at the same time were changed from single high stage compressors, taking their air from the maneuvering air system to independent three stage compressors. For the two low pressure air compressors, one of which was always operated at sea, was substituted one motor driven compressor for maneuvering purposes only. This latter arrangement is better in that the high and low pressure air systems are not interdependent and the auxiliary power plant is more flexible. From an operating standpoint it is also better, as, by having more than two sets and being small in size, they can be overhauled in turn at sea, relieving the work of the engineers' personnel in port, whose time should then be given to more important port duties.

There has been much discussion as to whether the two or four cycle engine is better. Judged in the light of the number of motorships in successful operation, at present the four cycle has the decided advantage.

Two vs. Four Cycle Engines

The special claims made for the two cycle engine is that more power can be obtained per cubic space of cylinder, from having double the power strokes of a four cycle, and hence less weight and space occupied; also that the two cycle, having no exhaust valves to cause trouble, can burn the lower grade oils of high sulphur content.

The four cycle advocates dispute these claims by saying that the two cycle engine cannot run with as high mean pressures in the cylinders as the four cycle, if internal heat troubles are to be avoided; and that the combustion is not apt to be as complete as in the four cycle. They also point out the lower mechanical efficiency, resulting from negative work required for scavenging, and hence higher fuel consumption. With the rings passing across the open ports wearing conditions are not so good as with the unbroken liner surface of the four cycle, and the cylinder lubricating oil consumption is much higher than the four cycle due principally to the oil being scraped into these ports and blown out through the exhaust. It is also stated that with the long pistons required, scoring is apt to result from misalinement caused from wear at crossheads and guides. The two cycle originally dominated the field of the light high speed submarine engine, but after some ten years have been spent in its development it has been superseded in this field to a great extent by the four cycle. This would not have been possible if there is any inherent advantage in the two cycle as to weight for a given output. Moreover, in the long trade routes, which is the merchant motorship's chosen field, it must be obvious that the conceded superior economy of the four cycle will give an advantage in deadweight cargo capacity more than sufficient to offset the advantage in weight of machinery claimed, but not yet proved, by the two cycle advocates.

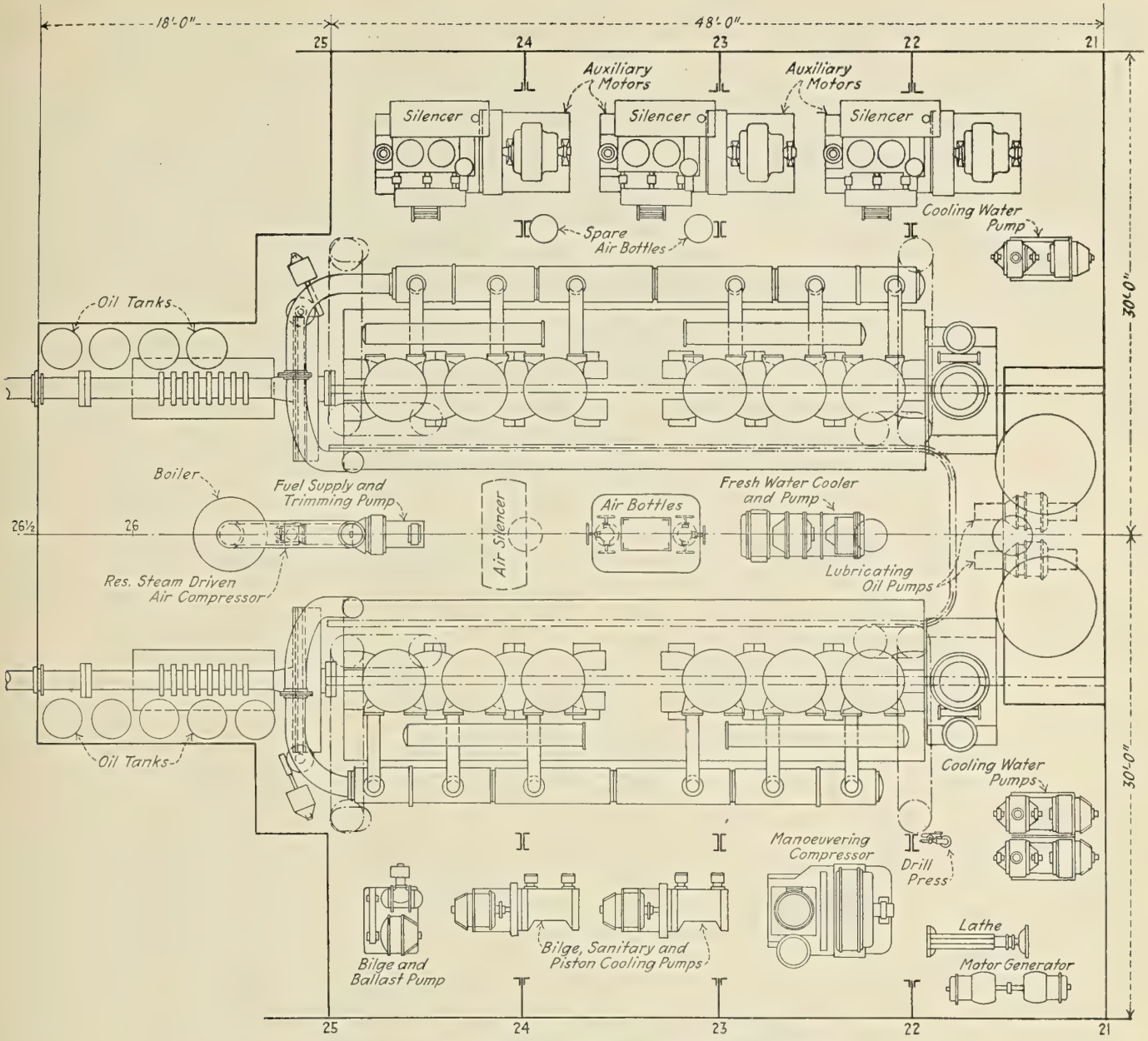
Some makers, who originally built four cycle engines and changed to two cycle, have in recent years changed back to four cycle, and others, who have always built the four cycle, are known to be experimenting with the two cycle. All experienced builders are fairly well agreed, however, that the Diesel engine works best at low speeds due to the nature of the injection and burning of the oil, and that the large cylinder engines better burn the lower grade oils. Oil of higher sulphur content, though, as commonly used under boilers, is not to be recommended, as the sulphuric acid formed in the burning not only affects adversely the exhaust valves of the four cycle engine but attacks impartially the exhaust pipes and other parts of either the four or two cycle.

Solid Fuel Injection

Some makers have advocated the solid injection or injection of the fuel by pressure alone, with which Vickers has been most successful. The chief difficulties encountered with such a system are in getting good combustion at all running speeds and loads and the elimination of the shock in the cylinder, which is apt to occur with the sudden rise in pressure when fuel is injected. The advantage claimed is that compressor troubles are entirely eliminated with a correspondingly higher mechanical efficiency obtained than with air injection. The fuel consumption, often erratic, however, under the most favorable conditions, is no better than the air injection full Diesel. It is also questioned if an oil pressure from 2,500 to 4,000 pounds per square inch is more to be preferred than an air compressor and its corresponding air system having a pressure of 850 to 900 pounds.

The Diesel electric drive has been suggested by some, using direct current supplied by several high speed engine sets working in series. The sponsors of this system apparently have either taken their cue from the turbine electric drive or are more familiar with the electric end than the shortcomings

*From a paper read before the Society of Naval Architects and Marine Engineers, New York, May 26.



Arrangement of Machinery, Motorship William Penn

of the high speed Diesel engines. To reduce the weight of the engines and space occupied sufficiently to compensate for the additional electrical equipment involved, the engines must necessarily be high speed and of the trunk piston type. The engines would correspond in design to that halfway between land and submarine practice.

Disadvantages of Diesel Electric Drive

The disadvantages of such a system compared with the direct drive are as follows:

1. Loss in reliability in the prime movers.
2. More major overhauls, as lifting of cylinder covers and drawing of pistons, due to poorer combustion and passage of lubricating oil from crank case.
3. About 30 percent more fuel per knot, 15 percent chargeable to higher fuel consumption of engines and at least 15 percent electrical losses with the small size generators used.
4. Lighter grade and more expensive fuel oil required.
5. Much higher lubricating oil consumption associated with high speed and trunk pistons.
6. Possible vibration troubles associated with high revolutions.
7. Necessity for using objectionably large motors of the commutator type for transmissions of power from engines to propellers.
8. Greater complication of controls and more expert knowledge required of the engineer personnel.
9. Tendency to overwork the personnel with the frequent overhauls required with high speed engines when operated continuously at full power.
10. Danger of short circuits.
11. Short life of high speed engines compared with slow speed engines.
12. Higher first cost and maintenance charges.

With the higher consumption of fuel and lubricating oil per indicated horsepower combined with the electrical losses involved and the better quality of fuel oil required, the total expenditure for these items will be about 50 percent more than with the direct drive system.

The Diesel electrical system has been specially recommended for converting existing steamers. It is believed by the authors that this can be far better accomplished by using a long stroke engine turning at the low revolutions required. Work has been done along these lines by Doxford and Cammell-Laird, using the doubled opposed piston, and also Burmeister & Wain have developed a line of long stroke engines, with a stroke bore ratio of two to one, specially adapted to single screw vessels. These latter engines are to be recommended for new vessels, as well, of 5,000 tons deadweight and less, on account of less engineroom personnel required, important in small vessels, and the dispensing with one shaft alley, which is also important in this size ship.

For new motorship construction, over 5,000 tons deadweight, two screws are to be recommended. In smaller vessels there is little difference in propulsive efficiency between single and twin screws. For larger ships, however, the efficiency is more favorable with the two shaft arrangement due to well known conditions affecting propeller performance, including the better immersion of the two smaller propellers under all conditions of draft. In the larger vessels, also, the saving in space by having only one shaft alley is not so important, and the length of engineroom will be less with the higher speed standard stroke engines.

A comparison will be given showing the estimated increased earning capacity of a motorship over a corresponding oil burning steamer as can be anticipated in actual service. The size of vessel chosen has the same general dimensions as the motorship *Afrika*, owned by the East Asiatic Company, and which is similar to the *William Penn* and the two motorships building for the United American Lines.

Comparative Earning Capacities of Motorship and Oil Burning Steamer

The steamer is single crew with double reduction gearing and compound turbines and Scotch boilers. The revolutions for the vessel are taken as seventy, which is conservative practice, to favor propulsive efficiency which for convenience here is assumed the same as the twin screw vessel.

The ships are of the awning deck type having a nominal deadweight carrying capacity of 13,000 tons when loaded to 31 feet 5 inches draft. They are 445 feet between perpendiculars, 60 feet beam and 42 feet molded depth, with a block coefficient of 0.782. The shaft horsepower of the turbines is taken as 3,500 which is equivalent to the 4,500 indicated horsepower of the Diesel engines. The cost of the vessels to build, based on probable cost of labor and material in the immediate future, is assumed $150 per ton for the steamer and $165 for the motorship. The $200,000 additional cost of machinery for the motorship, including deck machinery, is considered fair where the Diesel work is well standardized.

The fuel oil consumption at sea for the steamer with 16 degrees Baumé oil is taken as 0.95 pound per shaft horsepower, all purposes, which should be realized in service with properly designed turbines and double reduction gears and coordination of auxiliaries. For the motorship, with oil of 22 degrees Baumé, the consumption is taken as 0.31 pound per indicated horsepower all purposes, which is usual with motorships belonging to the East Asiatic Company. The cost of oil in American port, per recent quotations, is $2 for fuel oil for steamer and $2.30 for Diesel oil of gravity indicated. It is necessary for the steamer to take on additional oil in a foreign port which is assumed double that in an American port.

The route chosen is from San Francisco to the Far East and return, calling, for example, at Yokohama, Hong Kong, Manila and Honolulu, with a total distance of 15,500 knots. The number of days at sea and in port is taken from percentages for similar vessels operating over similar routes, and the number of days in port include that for loading and unloading, repairs and docking, holidays, etc.

The cost of personnel is based on the scale of wages in effect the first part of this year with sustenance at $1.25 per man. This is estimated with 27 for the deck officers and crew for either vessel, and for the engine room 19 and 14 men respectively for the steamer and motorship.

The freight rate for bulk cargo is estimated as $27 per 100 cubic feet and for deadweight cargo as $13.50 per ton, which is fairly well in accordance with present rates.

The itemized figures are as follows:

	Steamer	Motorship
Displacement, tons	18,690	18,730
Gross tonnage, tons	9,059	9,050
Actual mean sea speed, knots	11.5	11.5
Revolutions per minute	70	115
Indicated horsepower	.....	4,500
Shaft horsepower	3,500	.....
Total weight of machinery (tons), including pipes, ventilators, ladders, floor plates, spares, tools, outfit, propellers, shafting, etc	690	911
Water in system, tons	115	14
Weight of deck machinery, tons	140	155
Weight of hull fittings, equipment, etc., tons	4,575	4,600
Light displacement, tons	5,520	5,680
Capacity, deadweight, tons	13,170	13,050
Capacity (bales), cubic feet	590,000	620,000
Oil bunker capacity, tons (double bottoms)	1,320	1,350
Oil bunker capacity, tons (tank between tunnels)	.....	120
Oil bunker capacity, tons (settling tanks)	80	20
Total oil bunker capacity, tons	1,400	1,490
Oil consumption per shaft horsepower, main engines, all purposes, pounds	0.95	.....
Oil consumption per indicated horsepower, main engines, all purposes, pounds	.....	0.31
Oil consumption per day at sea, tons	35.65	14.95
Oil consumption per day in port, tons	5.5	.7
Number of days at sea, per annum	220	220
Number of days in port, per annum	145	145

15,500-Knot Voyage

Days at sea	55.5	55.5
Days in port	36.5	36.5
Total oil consumption at sea, tons	1,980	830
Total oil consumption in port, tons	200	26
Reserve oil bunker (for about six days), tons	220	90
Total oil carried, outbound, tons	1,400	946
Total oil burned on trip out, tons	1,090	428
Total oil necessary, homebound, tons	1,310	518
Oil to be purchased abroad, tons	1,000	0
Weight of crew and stores, tons	50	50
Fresh water on board at start of each leg, tons	300	75
Total weight of vessel, including fuel, water, etc., outbound, tons	7,270	6,751
Total weight of vessel, including fuel, water, etc., homebound, tons	7,180	6,323
Cargo capacity, outbound, tons	11,420	11,979
Cargo capacity, homeward, tons	11,510	12,407
Cargo capacity, average (two ways), tons	11,465	12,193

Cost of Operation Per Voyage

Insurance (4 percent; depreciation 5 percent), 92 days	$44,200	$48,800
Brokerage, at 8/15 per ton cargo capacity	3,440	3,660
Overhead and general expenses at $20 per gross ton, per annum	45,600	45,600
Fuel oil	45,900	15,260
Water, at $1 per ton	600	150
Deck officers, crew, stewards	12,200	12,200
Engineer personnel	9,300	7,600
General stores, deck, engineers and stewards	5,000	5,000
Totals	$166,240	$138,270
Loading and discharging of deadweight tons at $1 per ton and 75 percent of cargo capacity	$17,200	$18,280
Total cost for deadweight cargo (per voyage)	$183,440	$156,550
Loading and discharging of bulk cargo at $2 per 100 cubic feet at 75 percent capacity	17,700	18,600
Total operating cost for bulk cargo (per voyage)	$183,940	$156,870

Comparison of Earnings with Deadweight Cargo Carried

Tons per voyage outbound at 75 percent capacity	8,500	8,980
Tons per voyage homeward at 75 percent capacity	8,640	9,300
Rate per ton	$13.50	$13.50
Gross revenue per voyage at 75 percent capacity	$232,500	$246,780
Cost of operation per voyage	$183,440	$156,550
Net revenue per voyage	$49,060	$90,230
Net revenue per annum	$195,000	$358,900
Percent earned on investment	10	16.65

Comparison of Earnings With Bulk Cargo

Cubic feet of cargo carried out and return at 75 percent capacity	885,000	930,000
Rate per 100 cubic feet	$27	$27
Gross revenue for bulk cargo	$238,000	$251,100
Cost of operation per voyage	$183,940	$156,870
Net revenue per voyage	$55,060	$94,230
Net revenue per annum	$218,500	$374,000
Percent earned on investment	11.2	17.4

From the foregoing it will be seen, for the particular conditions chosen, that the motorship has an increased earning capacity over the steam vessel of 66 percent on deadweight and 55 percent when bulk cargo is carried. In addition to the bulk cargo, there can be carried on the outbound trip 544 tons of oil, which, at $13.50 per ton, will increase the amount earned on investment from 17.4 percent to 18.73 percent or 67 percent better than the steamer.

The above figures can be used as a basis for working out a comparison for any route which will vary directly with length of voyage and the size of the vessels employed.

The Motorship William Penn

A brief description of the motorship *William Penn* will be given, as it was the first large vessel of this kind owned by

the United States Shipping Board. The performance of this vessel in service will be of particular interest, as it is to be operated over the same route and by the same operating company as the electrically driven ship *Eclipse,* recently put into service.

The hull, having been originally intended for a 3,000 shaft horsepower single screw turbine installation, is not exactly suitable to the Diesel engine installation of 4,500 indicated horsepower, or 3,500 shaft horsepower. For best efficiency, due to its high block coefficient, the vessel should not be driven over 10½ to 11 knots in service. The screws have accordingly been designed for lower turns than that for which the engines were intended, so that the designed mean indicated pressure, upon which the efficiency of engines somewhat depends, will be maintained.

The *William Penn* has a length between perpendiculars of 439 feet 6 inches, a beam of 60 feet, a depth molded to shelter deck of 36 feet 8 inches, and a draft of 28 feet 4¾ inches, corresponding to 12,375 tons deadweight. The length of engine room space was maintained the same as for the steam driven sister ships. A built-up column was added to tie the middle of the engine room double bottom to the shelter and bridge decks, to prevent possible synchronous vibrations being set up between the main engines and the hull's structure.

The main engines are, as previously stated, six cylinders, each of a bore and stroke of 740 millimeters and 1,150 millimeters, respectively. Along the port side are arranged the three auxiliary engines each driving 65 kilowatt generators, and along the starboard side the maneuvering compressor and bilge and ballast pumps. The lubricating and salt water cooling pumps are placed near the forward bulkhead and the fuel oil pump and reserve air compressor aft, between the main engines. In this vessel a fresh water closed cooling system, with cooler and fresh water pump, has been added for the cooling of the cylinders and covers. This is a precaution against mud being deposited in the spaces, which is liable to occur with deep draft vessels when navigating shallow waters and rivers. The salt cooling water is maintained for the main compressors and piston cooling, which is also used for cooling the fresh water.

Germany to Build High Powered Diesels

By Our Special London Correspondent

The prolonged coal strike in England has afforded a remarkable advertisement for the motorship and it is a fact of more than ordinary significance that while there are now millions of tons of steamships laid up, there do not appear to be any large motor vessels idle at the present time. Attention is now being concentrated on the construction of high powered engines and it will probably surprise most shipowners and shipbuilders to learn that Germany is making a determined attempt to lead the way in this sphere.

THE Hamburg South America Line is having built a large motorship in which a couple of 3,000 brake horsepower Sulzer Diesel engines will be installed. These engines are under construction at Sulzer's German works at Ludwigshaven and are the biggest of the type yet built for marine purposes. They are six cylinder engines with a diameter of 680 millimeters and a stroke of 1,100 millimeters developing their full power at 100 revolutions per minute. From the purely technical point of view, these engines are noteworthy in that they inaugurate a novel system of scavenging which Sulzers have now decided to employ in all their large sets.

Turbo Scavenging Pumps for Diesel Engines

In the Sulzer engine the principle of scavenging is to have two series of scavenging ports at the lower end of the cylinder, the bottom one being opened and closed by the passage of the piston in the course of its stroke, while the supply of scavenging air entering through the upper ports is controlled by semi-rotary valves operated from a horizontal spindle in the scavenging trunk. Sulzers have retained this general design but instead of supplying the scavenging air from a vertical pump driven directly off the engine, two electrically driven turbo scavenging pumps are installed in the engine room, one of which will supply sufficient scavenging air for both the propelling engines, the other remaining as a stand-by. In this way it is possible to obtain an extra 6 or 7 percent power on the shaft as this is the amount normally absorbed by the scavenging pump. Moreover it is claimed that no larger electric generating sets are required in the engine room since in any case with electrically driven winches it is necessary to install an electric generating plant of sufficient power to operate them when in port. When at sea this same power can be used to drive the scavenging pumps and no additional plant is necessary.

Taking a ship equipped with two 2,000 brake horsepower Diesel engines, and provided with electrical auxiliaries, the auxiliary generating plant might comprise two 400 horsepower sets. The scavenging pumps needed would be two of about 250 brake horsepower, one being sufficient for supplying scavenging air to both engines. When in port, one generating set would be sufficient to operate all the winches, while at sea one set would also carry out the whole of the work required including driving the scavenging pump and all the minor electrical auxiliaries.

A Geared Diesel Engined Liner

Among other high powered motorships that will shortly be built are two equipped with 6,000 horsepower machinery for the Hamburg America Line, now approaching completion at Hamburg. These are remarkable as forming the first examples on a large scale of the application of geared Diesel drive. In these vessels the twin screw engines, each of 3,000 horsepower, run at 390 revolutions per minute and drive the propellers at about one quarter of this speed through the intermediary of ordinary mechanical gears. The engines are two of the numerous sets which were actually built during the war for installation in submarine cruisers and have ten cylinders of 530 millimeters bore and stroke. They are four cycle M. A. N. machines and are similar to the submarine engines used in the German Navy during the war except that the number of cylinders has been increased from six to ten.

5,000 Horsepower Camellaird Fullagar Engine

In view of the attention now being paid to the Camellaird Fullagar engine it will interest engineers, shipowners and

Fig. 1.—The 10,000-Ton Motor Tanker Seminole Built and Engined by Vickers for the Anglo-American Oil Company

shipbuilders in the United States to know that the largest individual marine engine now being built is one of this design under construction at Cammell Laird's own works at Birkenhead. It is to develop 5,000 brake horsepower in six cylinders running at 95 revolutions per minute, the cylinders being only 26½ inches in diameter with a stroke of 42 inches.

Cammell Laird's has just completed a twin screw set of two 1,000 brake horsepower engines, the largest of this type yet built. The illustration shows these on the test bed on the occasion of their official trial run. They develop their normal power of 1,000 horsepower at 115 revolutions per minute and have four cylinders 18½ inches diameter and 50 inches combined stroke. The principle of operation of the Camellaird Fullagar type is now so well known that it need not be explained but the most interesting fact in connection with the trials of the engine is that they achieve what is apparently a record fuel consumption for ordinary Diesel engines as this works out at 0.39 pound per brake horsepower hour. Remembering that it includes the fuel required for operating the scavenging pump, the three stage air compressor, the circulating water and lubricating oil pump, it will be agreed that the result is noteworthy, exceeding in economy as it does the most efficient four stroke design which has as yet been worked out.

Results with the Still Engine

The first official test results of the Still combined steam and oil engine are now available and although they are better than anything that has yet been recorded, there is still some doubt whether the complication of adding a steam boiler with the necessary pumps to the Diesel engine, not to speak of the steam valves on the working cylinder, is warranted by the economy compared with the ordinary Diesel motor. The lowest figure recorded on the trials at full load of a single cylinder engine developing about 350 brake horsepower was 0.375 pound per brake horsepower hour. This included all the auxiliaries, as well as a separately driven scavenging pump which incidentally absorbs only four percent of the total power. This engine has been built at Scott's Shipbuilding and Engineering Works on the Clyde and details of it were recently published.

It is hoped by the manufacturers that still better results will be achieved and in any case it is of course not possible to obtain the maximum efficiency on a single cylinder unit. The engine will be built as a six cylinder machine developing 2,000 brake horsepower and it is hoped that on this engine consumption, overall, of less than 0.36 pound will ultimately be achieved.

A number of interesting motorships have been launched

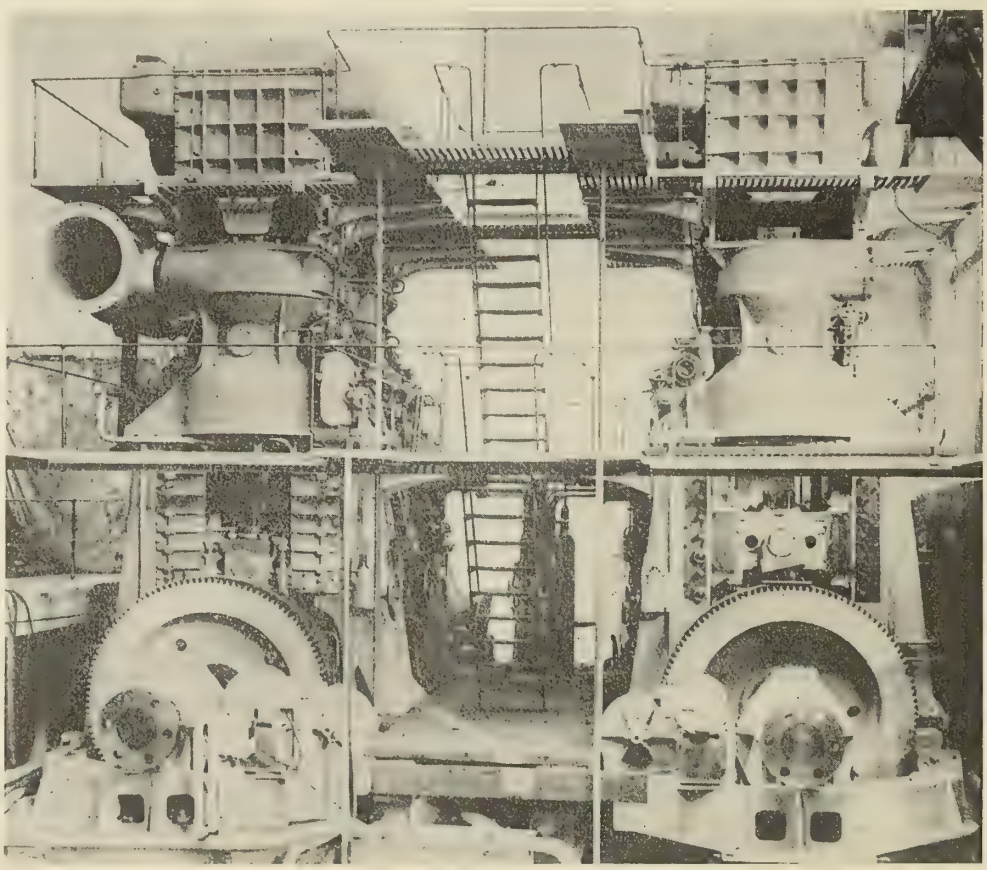


Fig. 2.—Two 1,000-Brake Horsepower Cammellaird-Fullagar Diesel Engines—the Largest of the Type Yet Built

or completed during the past few weeks including the *Seminole,* now trading between England and New York, and an oil tanker built by Vickers for the Anglo American Oil Company. This is a second ship to have the standard Vickers solid injection Diesel engine, which is proving much more successful than the opponents of the solid injection system anticipated would be the case. This 10,000-ton ship with a speed of 11 knots has a fuel consumption of only about 10 tons daily.

Another new ship is the ore carrying vessel *Strasse* for the Grangesberg Oxelsund Company built by Götaverken and designed to carry about 8,000 tons, while a third is the Tosi engined *Primula,* one of the first ships in which machinery of this type has been installed. The motorship *Sardinia,* a single screw vessel with a 2,100 horsepower Werkspoor engine, has recently been completed and two or three others will shortly be finished.

Progress in motorship building is proceeding along steady lines in spite of the desperate shipbuilding slump which in fact will probably prove a blessing in disguise for the motorship builders.

S. S. Henry Deutsch De La Meurthe: Deadweight Tonnage, 8,350; Indicated Horsepower, 2,833; Speed, 12.90 Knots

Tankers Delivered to Lux Navigation Company

FOLLOWING a very successful deep sea trial run on May 20, the second of two steel tankers built at the Sparrow's Point Plant (Baltimore, Md.) of the Bethlehem Shipbuilding Corporation, Ltd., for the Lux Navigation Company, London, Eng., has been delivered to her owners. The first one of these tankers was delivered on May 10.

The *Henry Deutsch De La Meurthe* and the *Emily Deutsch De La Meurthe,* as the vessels are named, are similar in design to the well-known "Shell" tankers, and are built on the longitudinal system of framing. They are classed at Lloyd's highest rating. The total carrying capacity of each of these tankers is 8,350 tons deadweight on a mean draft of 24 feet 9 inches, with an oil cargo capacity of about 7,600 tons. The principal particulars are as follows:

Length overall, 427 feet.
Length between perpendiculars, 412 feet.
Extreme breadth, 53 feet 3½ inches.
Molded breadth, 53 feet 1 inch.
Molded depth to upper deck, 31 feet.
Molded depth to main deck, 24 feet.
Speed, 11 knots.
Type of engine, reciprocating.
Size of engine, 27 inches by 45 inches by 75 inches by 48 inch stroke.
Boilers, Scotch.
Number of boilers, 3.
Steam pressure, 180 pounds per square inch.
Kind of fuel, oil and coal.

The Bethlehem (Dahl) mechanical oil burning system is installed on each vessel, and the boilers are fitted with Howden's forced draft furnace fronts suitable for conversion to coal burning if desired. The engines and boilers are placed aft with the fuel oil tanks forward of the boilers. Bethlehem-Weir horizontal fuel oil pressure pumps, 6 inches by 4 inches by 8 inches, are installed in duplicate for supplying oil to the burners. The pump room is located near amidships, and is approximately 8 feet long and of the same width as the vessel.

Two Bethlehem-Weir vertical simplex cargo pumps, 18 inches by 16 inches by 24 inches stroke, are utilized for handling the oil cargo on each ship. Feed, drain, fuel oil transfer, ballast and deck, and donkey and fire pumps are of the same type. The main circulating pump is a 14 inch double suction centrifugal type, direct connected to an 8 inch by 8 inch vertical single steam engine. The deck machinery for each vessel consists of two 8¼ by 8 inch gypsies located on the upper deck, a hand operated capstan on the forecastle deck, two 8¼ inch by 10 inch compound geared winches on the upper deck, a 10 inch by 10 inch triple spur geared windlass, and a 9 inch by 9 inch horizontal spring-quadrant steering gear controlled by hydraulic telemotor. The auxiliary machinery was built at the Moore Plant of the Bethlehem Shipbuilding Corporation, Ltd.

On the trial of the *Henry Deutsch De La Meurthe,* which was run on April 21, an average speed of 12.90 knots was maintained at a mean draft of 24 feet 9 inches. An average of 2,833 indicated horsepower was developed at an average engine speed of 79.34 revolutions per minute. On the trial of the *Emily Deutsch De La Meurthe,* which was run on May 20, the average speed maintained was 12.36 knots at a mean draft of 24 feet 10 inches. An average indicated horsepower of 2,985 was developed at an average engine speed of 79.25 revolutions per minute. During the trials of both vessels the fuel burned was oil with a gravity of 28 degrees Baumé.

Standardized Diesel Engines—V*

Discussion of the Double Acting Two Cycle Engine and Its Possibilities

By H. R. Setz

THE climax of the general engine structure with automatic plate valve port scavenging control, described in the previous issue, is reached in the double acting two cycle engine. An examination of Figs. 23 and 24 shows such a design based on the same bore and stroke dimensions as in the single acting four cycle and two cycle engines shown respectively in Figs. 2, 3, 16 and 17. The cylinder proper here consists of an upper and a lower section, both rigidly held near their outer ends; their inner ends are slidably centered in a separate belt section which is mounted on the planed upper face of the cylinder beam. Freedom of alinement for each cylinder unit as well as unrestricted longitudinal expansion and contraction of each cylinder section are insured in the same ideal manner as with the previously described engine types.

One-half of the port length being in the upper cylinder end and the other half in the lower, these can be conveniently milled out of the solid cylinder wall to a nicety of form which greatly contributes to a clearly defined direction of flow of the scavenging air when entering the cylinder. To facilitate ease of travel of the piston rings over the gaps necessary between the cylinder ends to allow for expansion, these are made staggered relatively to each other between consecutive ports. An axial contact surface between the cylinder ends, located between the scavenging and exhaust ports, checks the flow of exhaust gases through the expansion gap without restricting movement of the cylinder ends. Indirect cooling for the ends of the cylinder wall around the ports is obtained by direct contact over their entire outer surface with thoroughly water cooled walls of corresponding contour in the surrounding belt section.

Transmission of Longitudinal Working Loads

A feature worthy of special notice is the transmission of the longitudinal working loads through the outer cylinder wall directly to the cylinder bolts without causing the belt section containing the ports to participate in any load transmission. The latter is at all times under compression, a feature especially pronounced on the exhaust port side; the advantages of this will be appreciated, if it is remembered that cylinder trouble on many early two cycle engines could be directly traced to the absence of such provisions. Surrounding this belt section with the ports we have again the scavenging air receiver, here built up of easily removable steel plates and running the entire length over the top of the cylinder beam.

Owing to the use of the port scavenging control already described and illustrated in Fig. 19, the high pressure ends of the cylinder castings have been stripped of the multitude of valve pockets and irregular passages which have so enormously complicated double acting engines, both two cycle and four cycle, as heretofore built. The elimination of valve operating gear with the inevitable cumbersome linkage and mechanism indispensable for actuating valves in different planes and different centerlines simplifies the construction so much that the double acting feature is at first hardly recognized.

An examination of the sectional view (Fig. 23) shows that these results have been accomplished without introducing a single element which has not been tried and proven by well matured experiences gained from double acting gas and Diesel engines of large capacity. Such features are the joint between the two cylinder sections in a plane through the ports, the water cooled metallic stuffing box and the lower cylinder head with integral water jacket which is assured of the desired flexibility because of the large difference in diameter between the inner and outer walls. The upper end of the cylinder is closed off by the same cylinder head as was used in the single acting engine.

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Interchangeability of Parts

From the under side of the cylinder beam down, every part of the engine is interchangeable with the parts which have been used on the single acting two and four cycle engines of the same stroke and bore. The large connecting rod bolts and deep sectioned crank pin and crosshead pin boxes here find ample justification, as does the collar type of piston rod attachment shown sectionally in Fig. 24. The latter, by virtue of its heavy backing nut, ensures a positively secured joint between piston rod and crosshead while the engine is in operation, at the same time greatly facilitating the loosening of this connection and permitting withdrawal of the piston rod through the stuffing box.

A valuable advantage of this arrangement, which has helped to make it popular in large modern engine practice, is the ease with which clearance adjustments can be made without affecting the piston cooling water connections. The piston cooling gear can be taken over just as it stands from the types of engine already described. The effective diameters of the piston cooling tubes had to be made large for considerations of staunchness rather than of water conveying capacity; even for the increased requirements of a double acting piston they are more than sufficient.

Operation of Fuel Valve

What mechanical valve gear remains is confined to the camshaft, push rods and levers required to operate the fuel valve. Referring to Fig. 23, it will be seen that only one fuel cam is required per cylinder, or no more than were needed for the single acting two cycle engine. Since the rollers for head end and crank end are spaced 180 degrees apart, the proper timing of injection for the head end and crank end working strokes is automatically spaced at the proper interval.

The operation of tappet rod A by means of sector lever F (Fig. 25) is chosen for the two reasons that it permits varying needle lifts during operation and makes roller clearances and adjustments immune against upward or downward cylinder expansion. The shaft which constitutes the fulcrum for lever F, and to which arm E is keyed, is centered at M. The only effect of moving the center H upward or downward is to cause a minute change R in the radial distance of the contact point between tappet rod A and lever F, and consequently a change of no measurable magnitude in the lifts of the needle N. If, however, it is desired to vary the lifts of the needles in order to meet operating conditions, a movement of shaft M and lever E varying the tappet rod position anywhere between A and A_1, accomplishes this result without at the same time disturbing the timing in any way. By swinging tappet rod A entirely clear of the working surface on lever F into position A_2, the fuel valve will be put out of operation. This corresponds to the "stop" position on the hand maneuvering gear of the engine.

STANDARDIZED DIESEL ENGINES

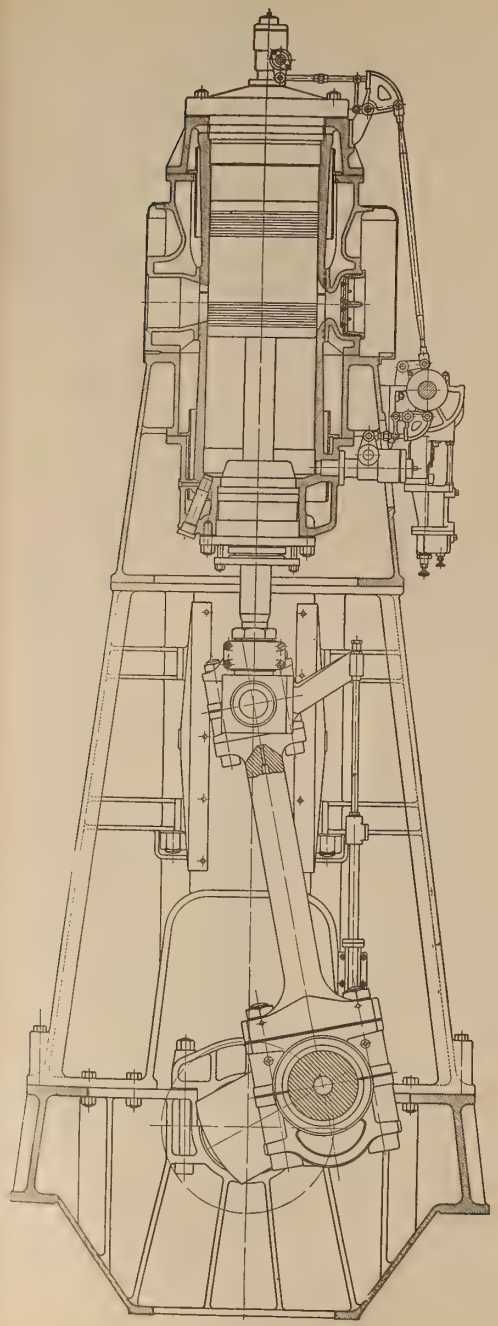


Fig. 23

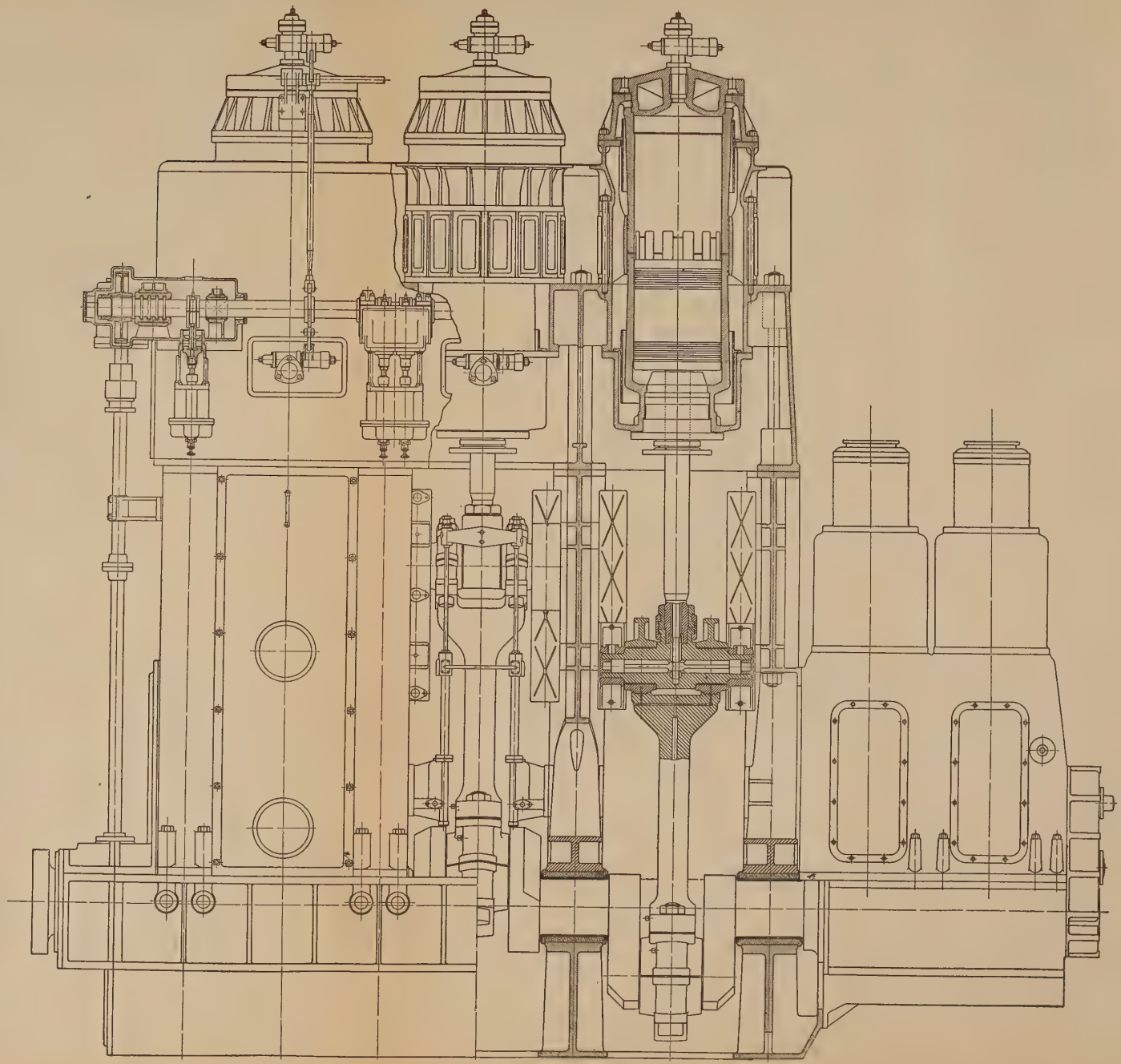


Fig. 24

The Ultimate Type of Reciprocating Engine Attained

With this two cylinder double acting construction we have arrived at the ultimate type of reciprocating engine; two power strokes from each cylinder per revolution and therefore the same degree of material utilization as is characteristic of the steam engine with the same fewness of parts. Like the latter, the favorite Diesel engine arrangement will be in the form of three cylinder units, for all except the largest sizes when four cylinders will be resorted to. Owing to the higher mean effective pressures obtained in the Diesel engine, its cylinders become smaller and the weight and space requirements less than those of a steam engine of the same number of cylinders, rotative speed and capacity. Over the latter the Diesel engine possesses the enormous advantage of having all its cylinders and the parts that go with same alike and interchangeable. The "individual job" feature so pronounced especially on marine

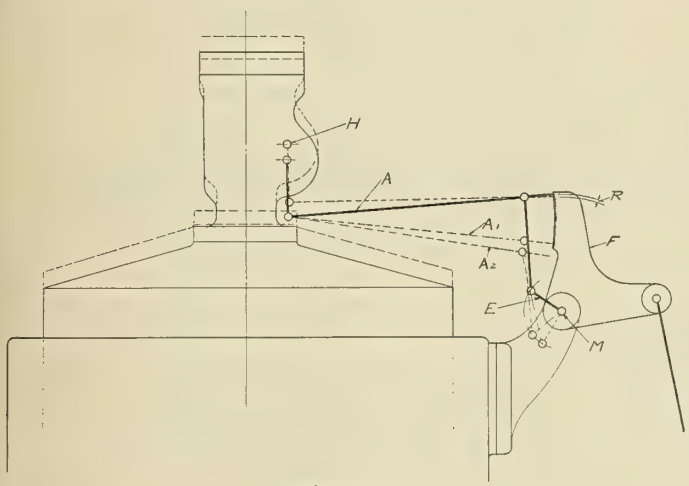


Fig. 25

steam engines is eliminated and in its place we have duplication of parts and quantity production.

As the foregoing exposition shows, this feature of duplication of parts inherent in all Diesel engines can, by consistent design, be expanded into a most pronounced duplication of use of the same parts on various types of engines. In this manner it becomes possible to distribute the appreciable first cost of one set of patterns, tools and fixtures over a line of units having a wide range of capacity and application, a manufacturing advantage of almost revolutionary significance.

Not the least economy and adaptability to meet a wide range of demands is furnished by the fact that in plants where the nature of service requires units of different capacities this can be met to a heretofore unknown extent with engines of the same bore and stroke of the double acting type for the larger units and single acting ones for those of smaller capacity; the latter can, by the use of identically the same framing and over 90 percent of the same moving parts, always be converted into units of greatly increased capacity at an almost nominal expense, a feature of importance alike for stationary and marine installations. The spare parts to be carried for either type of installation are virtually the same.

Possibilities of the Double Acting Two Cycle Engine

The extraordinary possibilities of the double acting two cycle engine are strikingly brought out by means of the comparative figures of Tables I and II. The first of these shows capacities, weights and principal overall dimensions of a set of three four cylinder engines having the same bore and stroke, built on the same bedplate and having all parts below the under surfaces of the cylinder except the four cycle crank shaft alike and interchangeable.

The four cycle engine is credited with higher rotative and piston speeds and also is based upon a greater mean effective

TABLE I

	Four-Cycle, Single-Acting	Two-Cycle, Single-Acting	Two-Cycle, Double-Acting
Number of cylinders	4	4	4
Speed, revolutions per minute	140	125	115
Continuous load capacity, brake horsepower	520	825	1,500
Weight of engine complete, including piping and grating, tons	76	*85	*97
Weight per brake horsepower, pounds	327	230	147
Overall length	22′ 0″	23′ 6″	24′ 6″
Maximum height centerline shaft to highest point on engine	14′ 6″	14′ 6″	16′ 10″

TABLE II

	Four-Cycle, Single-Acting	Two-Cycle, Single-Acting	Two-Cycle, Double-Acting
Number of cylinders	6	4	3
Continuous load capacity, brake horsepower	1,500	1,500	1,500
Speed, revolutions per minute	120	115	110
Bore and stroke, inches	27 by 42	25½ by 40	23 by 36
Mechanical efficiency, percent	74	72	79
Mean effective pressure, pounds per square inch	93	88	80
Weight of engine complete, including piping and grating, tons	235	*160	*100
Cost of manufacture, including patterns	$145,000	*$105,000	*$65,000
Overall length	39′ 6″	28′ 10″	21′ 6″
Maximum height centerline shaft to highest point on engine	18′ 9″	16′ 10″	18′ 3″
Fuel consumption per 24 hours, tons	6½	7	7¼
Lubricating oil consumption per 24 hours, gallons	30	40	20

*Including centrifugal scavenging pump.

pressure because of the low material utilization characteristic of this engine. Owing to the greater frequency of load and heat applications, and because scavenging in the lower ends of the cylinders is somewhat interfered with by the presence of the piston rods, a speed of only 115 revolutions per minute is assumed for the double acting engine and a similarly conservative rating has been observed for the mean effective pressure.

Even with these reductions, the double acting engine excels by a wide margin. The differences in weight are brought about, aside from the necessity of a scavenging air pump in the case of the two cycle engines, by the different sizes of maneuvering compressors needed for each type of engine, according to its capacity, which also accounts for the slight variations in overall length.

Table II shows a set of engines compared on a basis of equal horsepower. Similar reservations in regard to speeds and mean effective pressures, giving due consideration to the size of cylinders, have been made here as in Table I. A particularly low mean effective pressure rating has been assumed for the double acting engine, not so much with the idea of accepting this as the normal working load, but rather to emphasize its advantages compared with the single acting units whose higher rating more nearly corresponds to best modern practice.

The drastic reduction in number of cylinders from the four cycle single acting engine up to the two cycle double acting machine is accompanied with an almost equally emphatic reduction in bores and strokes. The decrease in number of cylinders enormously shortens the bedplate and renders it less sensitive to deflections due to inaccuracies of foundations or to the deformations of a ship's hull at sea. Owing to the shorter stroke the bedplate also becomes narrower, a circumstance which, together with the small flywheel that can be used here, makes it possible to place a double acting two cycle engine further aft in a boat, thus shortening the line shafting and tunnels.

The fuel consumption of the four cycle engine is somewhat lower than that of the two cycle units but it is by far the most expensive to build; on the other hand, lower grades and therefore cheaper fuels can be burned in two cycle en-

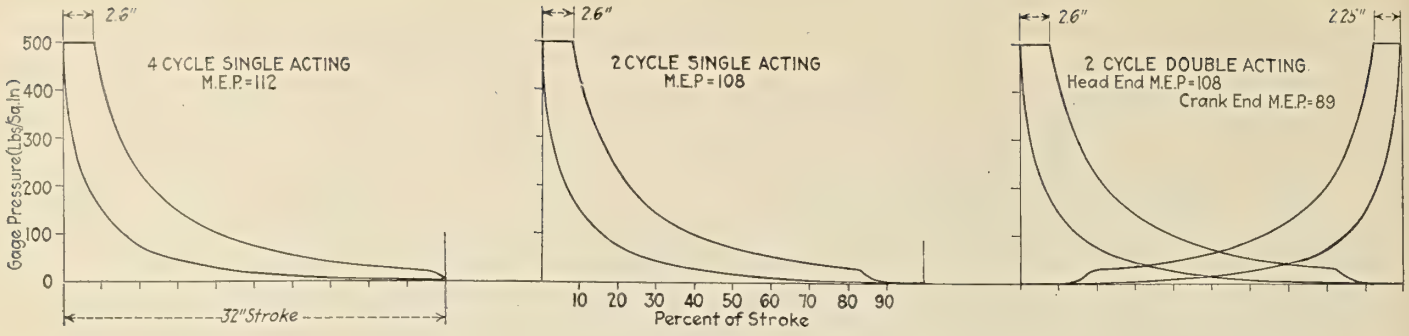


Fig. 26

gines, a fact which results from the absence of exhaust valves. The lubricating oil consumption of the double acting two cycle engine is less than that of the four cycle and approaches that of a steam engine of the same capacity, a

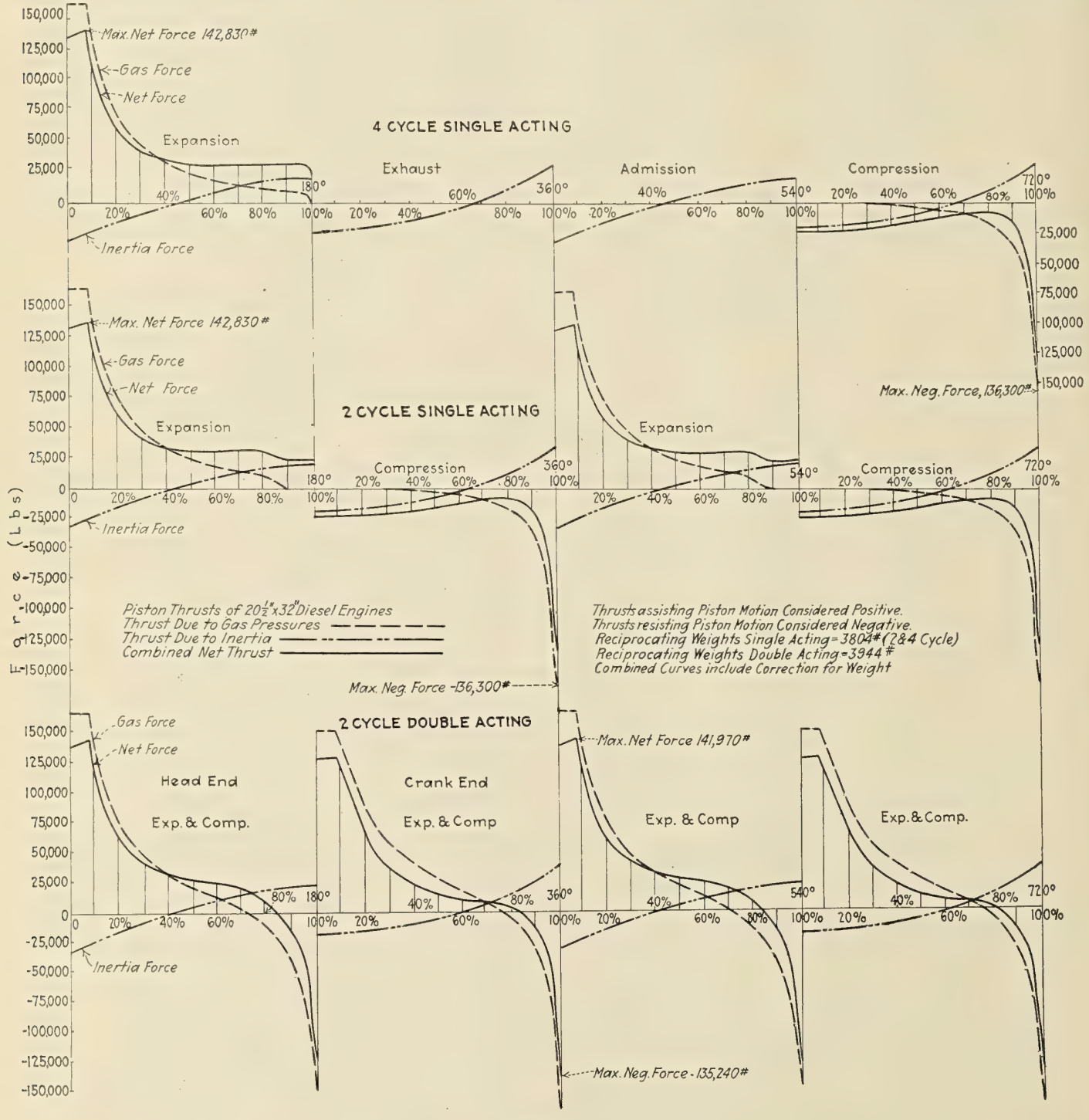


Fig. 27

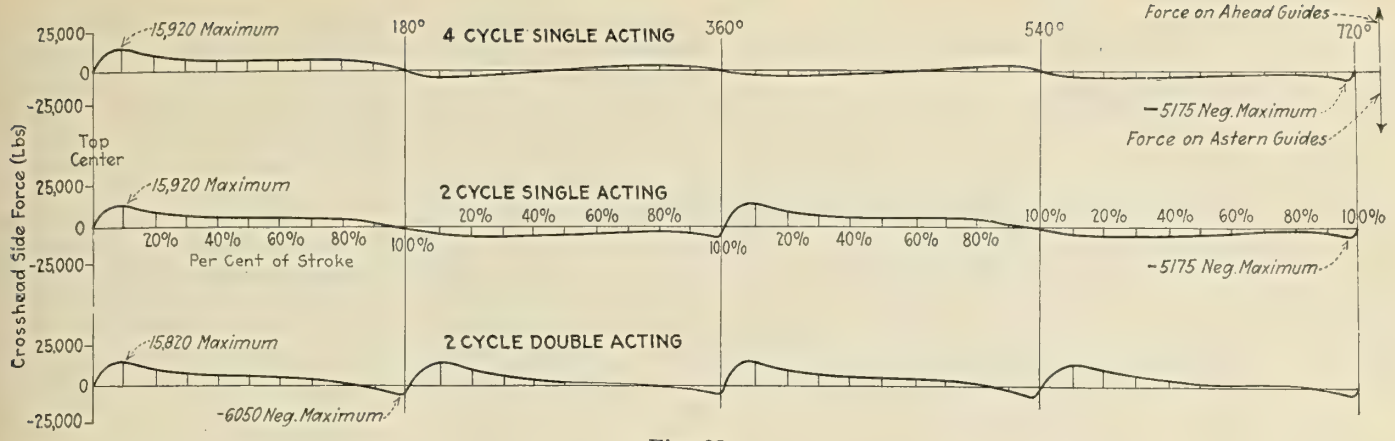


Fig. 28

saving which is due to the reduced dimensions and smaller number of moving parts.

Savings in Space and Weight and Costs

The most remarkable gain, however, is shown in the space and weight required and cost of manufacture, which readily explains itself from the fewness of parts and their greatly reduced size. The significance of this will be fully understood in the case of marine installations, where a three cylinder double acting two cycle engine can be put in the same space as a triple expansion steam engine of the same capacity and will not weigh as much as the latter with all its accessories; the entire space occupied by the boilers becomes available for cargo space. Thus, at a cost amounting to little more than that of a steam engine, it becomes possible to convert existing steamers into motorships without requiring extensive changes in the hull but resulting in a pronounced saving in cargo space and weight capacity. A logically constructed and installed double acting two cycle engine permits *new ships to be built at less cost than steamers and with an increase in cargo capacity equal to at least one-half the space and weight now required by first class steam equipment.* The rapid construction of such ships is greatly facilitated by the small number of engine parts and their relative simplicity which call for very much less machine shop and assembly work than single acting engines, a fact most convincingly expressed in the materially reduced manufacturing cost shown in Table II.

Nor do these gains from the manufacturing point of view exhaust the advantages of the double acting engine; an equally important gain can be scored from the viewpoint of operation. The greatly reduced number of moving parts, their extreme simplicity and all around accessibility are features which put this type of engine in a class by itself as regards convenience of operation. Not the least important point in this respect is the relative smallness, as compared with other types of engines, of the essential parts exposed to heat impulses, the cylinders, cylinder heads and pistons. Says Professor C. H. Peabody in MARINE ENGINEERING for September, 1920, page 754:

"The difficulty of cooling an internal combustion engine increases with the size in geometric ratio. As the thickness of the cylinder walls must increase with the diameter and the rate of flow of heat decrease with the cylinder volume, that is, with the cube of the diameter, the difficulty will increase in proportion with the fourth power, while the area of the surface increases only with the square. Consequently the difficulty of cooling increases with the square of the diameter of the cylinder; that is to say, it is four times as troublesome to cool a 200 horsepower engine as a 100 horsepower engine, for with constant piston speed and mean effective pressure, the power increases with the square of the diameter. Another way of looking at the matter is that with the same efficiency

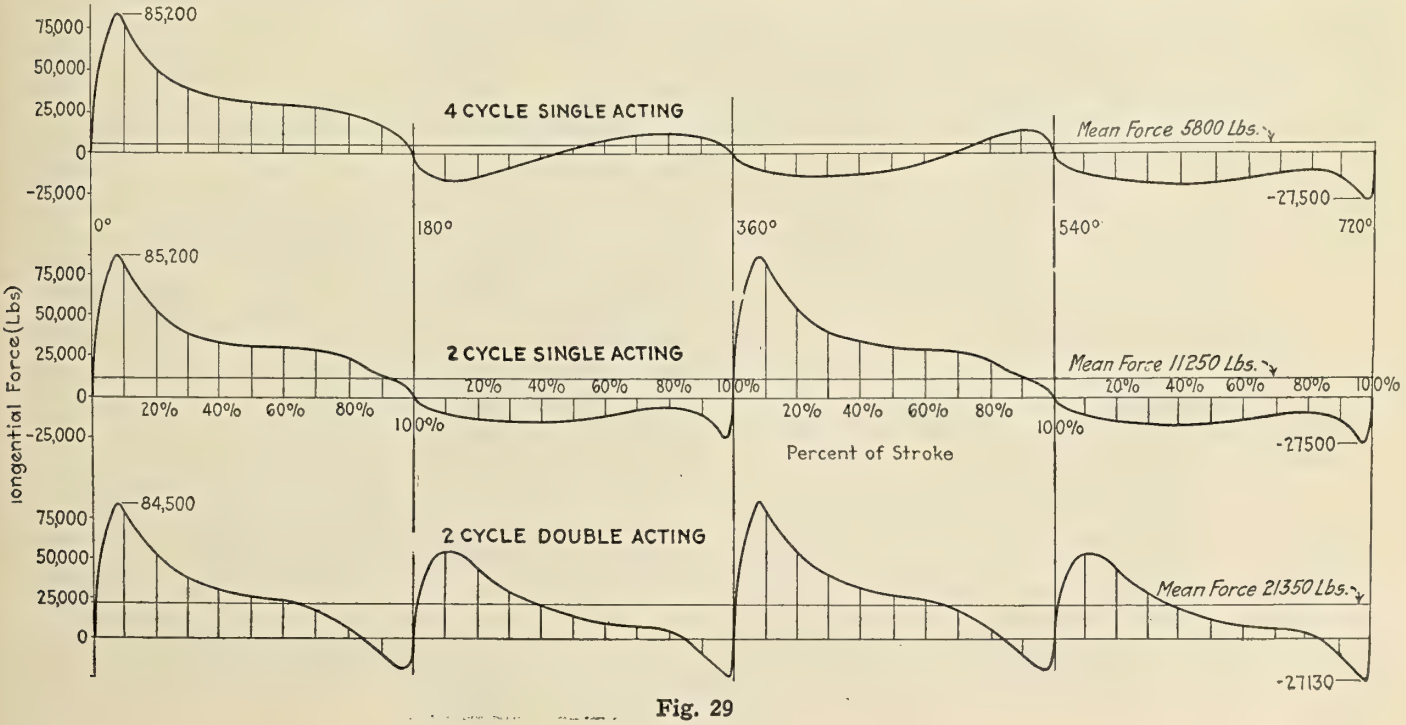


Fig. 29

of cooling the inside of the cylinder will be hotter for the larger engine. This comes from the fact that a greater difference of temperature is required to force the heat through thicker walls. We must not be surprised that there is a tendency to reduce piston speed and mean effective pressure for large engines."

The foregoing exposition shows how systematic planning and logical adaptation have led to a system of Diesel engine construction which, while incorporating only well established constructional features and principles, opens an entirely new directive of enormous potentialities. Questions of fundamental importance, such as two cycle or four cycle and single acting or double acting, can be solved in the easiest possible and only proper manner—by accepting the legitimacy of either type in its proper application, which is primarily a matter of speed and to a lesser degree of size. The adoption of either type will involve but one capital change, that of the cylinder with the necessary parts, and will amount to a small fraction only of the cost of those parts which under this system remain unchanged. This is possible, as a critical study of the various views shows, without having to make any concessions whatsoever at the expense of any one type. Furthermore, all the constructional forms resorted to are sanctioned by the most advanced specialized experience and none of the incorporated features or combinations is novel in the sense of requiring extensive experimental research to establish its functional suitability.

Appendix

Force and Turning Moment Diagrams

Fig. 26 shows ideal indicator diagrams for four cycle and two cycle single acting engines and for the two cycle double acting engine. In plotting them the exponent 1.33 was used and a length of cut-off chosen such as to give the mean effective pressures marked. In the four cycle diagram, an initial absolute pressure of 14 pounds per square inch was assumed to exist at the bottom dead center position preceding the suction stroke. The compression curves for the two cycle engines were drawn on the assumption that absolute scavenging air pressure of 18 pounds per square inch is established in the cylinders at that point where the piston recovers the inlet ports. The toes of the two cycle diagrams have been faired out to a characteristic two cycle shape.

On the basis of these diagrams the curves in Fig. 27 were plotted. They show net forces acting along the cylinder centerlines corrected and uncorrected for inertia. Since the weights used for calculating the inertia forces were computed from finished detail drawings of the engine parts, no uncertainties of estimation need be allowed for. No investigations of the connecting rod side throw were made; instead of that, an assumption well justified by more exact calculations, namely, that 35 percent of the weight of the connecting rod parts is concentrated at the crosshead pin center and 65 percent at the crank pin center, has been made.

As will be noted, the inertia forces do not play as great a part as they would, for instance, in a twin tandem horizontal engine. In the figures for inertia weights given in the illustration, 3,804 and 3,944, respectively, only a small proportion (513 pounds) is due to the piston extension and produces an effect which is hardly discernible in the diagrams.

A natural progression in the material utilization already noted in the tables comparing horsepower weights and sizes is again manifest here. The four cycle piston thrust diagrams show a large proportion of idling. The two cycle diagrams exhibit a marked improvement in this respect and the ultimate utilization and work capacity that can be realized is represented by the double acting curves.

The crosshead side forces shown in Fig. 28 are small in proportion to the net piston thrusts. Owing to the effect of inertia in producing side pressure even during the idling periods of the four cycle engine, the mean crosshead thrust encountered in the double acting engine is by no means proportional to increased capacity. With the double center crosshead construction used on these machines, it is a simple matter to provide surfaces amply sufficient to resist the thrusts of the double acting crosshead without heating.

The most interesting curves of the series are the tangential effort curves shown in Fig. 29. The increase in uniformity and the rise in the mean value of these curves re-inforce the impression, already deepened by the observations hitherto made, that the natural climax of fitness and material efficiency is reached in the two cycle double acting engine. The mean tangential force of the four cycle engine is 5,800 and its ratio to the maximum is only .068. This ratio for the double acting two cycle engine amounts to .253, a figure which speaks for itself.

Efficiency in Material Handling

ONE of the pressing business questions of the day is the elimination of industrial wastes. It is a factor that has an important bearing on the manufacturer's problem of meeting present economic conditions.

Industrial waste may represent either material, labor or time. Material wastes are concrete, tangible and for this reason have received closer study. On the other hand labor wastes and time wastes, particularly unproductive labor and time represented in the handling of material, have not, generally speaking, received the attention their importance as a definite opportunity for effecting certain economy in manufacturing justifies.

The accurate records listed below were made by the Yale & Towne Manufacturing Company on the cost of handling 600 tons of molding sand, from a freight car on the railroad siding to the molding room in the foundry, 200 feet away. Forty feet of this distance was a 12 percent grade up a concrete ramp, with a sharp, right-angle turn into the shop at the top.

Mechanical Method

Material handled: Molding sand.	
From: Freight car.	
To: Molding room storage.	
Distance: 400 feet round trip.	
Grade: 12 percent—40 feet long.	
Capacity of Yale dump body truck: 27 cubic feet.	
Men required: To load	5
Men required: To unload	4
Men required: To operate	1
Total men	10
Total time consumed to unload shipment of 600 tons: 4 days.	
Total cost of labor (9-hour day)	$183.60
Demurrage charges	None
Total expense	$183.60

Wheelbarrow Method

Material handled: Molding sand.	
From: Freight car.	
To: Molding room storage.	
Distance: 400 feet round trip.	
Grade: 12 percent—40 feet long.	
Capacity of wheelbarrow: 5 cubic feet.	
Men required: To load	5
Men with wheelbarrows	13
Total men	18
Total time consumed to unload shipment of 600 tons: 6 days.	
Total cost of labor (9-hour day)	$495.72
Demurrage charges (over 4 days, $25 per day)	50.00
Total expense	$545.72

Many more examples could be cited. Mechanical handling is one way of accomplishing more work for the same expenditure.

Problem of the Hull and Its Screw Propeller—IV*

Method of Estimating Effective Horsepower Delivered by a Propeller—Induced Cavitation—Wake Gain and Loss

By Rear-Admiral C. W. Dyson, U. S. N.

TO illustrate the method to be followed in making an estimate of the effective horsepower delivered by a propeller when the $I.H.P._d$ or $S.H.P._d$ and the speed of the vessel are known, take up the case of vessel *F*.

VESSEL F

Hull of the Dreadnought Type Having a Standard Basic Slip of Approximately 13 Percent

Propeller	
Number	4
Blades	3
Form	Standard
D	13.42′
P	15.17′
$P.A.$ / —	.3567
$D.A.$	
$T.S.$	7,760
$1 - S$	.86
V	23.97
$I.T._D$	4.97
$I.H.P.$	34,259 on four propellers
$P.C.$	.648
$E.H.P.$	22,200 on four propellers
$S.H.P.$	31,519 on four propellers

Ship steaming with one idle propeller on each side:

v	7	10	13 5	15
$\frac{v}{\sqrt{l}}$	.292	.4172	.5632	.6258
$S.H.P._d$	1,760	4,443	9,263	11,586
Z_s (curve I, Fig. 6)	1.44	1.0	.62	.49
s	.3995	.3661	.3182	.295
R_d	77.87	105.4	132.3	142.1
Act. R_d	75.9	101.9	132.1	143.85
$S.H.P.$	15,760	15,760	15,760	15,760
K	1	1	1	1
$\frac{e.h.p._1}{E.H.P.}$ for $\frac{v}{\sqrt{l}}$	.06	.122	.33	.545
Z_1	1.25	.94	.5	.27
Z_p	1.101	.745	.365	.202
$e.h.p. \div E.H.P.$	.105	.192	.442	.635
$e.h.p.$	1,166	2,131	4,910	7,050

In the above calculations

$$2Z_p = \log S.H.P. - \log S.H.P._d + Z_1.$$

It has been stated that with vessels of types 1 and 3 the transposition of Z_s from curve 1 to 2, Fig. 7 (see page 400, May issue), does not occur. This statement requires modification because it does happen when what may be called induced cavitation occurs. By this term is meant cavitation which is produced by means other than the conditions normally governing the performance of the propeller. It is frequently encountered with vessels of the destroyer type when propeller struts have been so constructed and fitted as to increase the squat of the hull and to produce areas of reduced pressure in the wake of the struts, the propellers working in these areas. In such cases the value of Z_s gradually passes over from curve 1 to curve 2, the departure from curve 1 for vessels of 310 feet load waterline length occurring approximately at a speed $v = 1.42\sqrt{L.L.W.L.}$ and arriving on curve 2 when $v = 1.92\sqrt{L.L.W.L.}$

To illustrate this phenomenon the case of a destroyer is given in which the shafts were carried by two struts each, the axis of the lower arm of each forward strut being parallel to the base line of the vessel, while the axes of the lower arms of the after struts were inclined downward at the forward edge 4½ degrees.

VESSEL G

Hull		*Propeller*	
$L.L.W.L.$	= 300.5′	Number	2
B	= 30.5′	Blades	3
H	= 9.583′	Form	Standard
$\frac{B}{L.L.W.L.}$	= .1015	D	92 5″
		P	82″
Nom. $B.C.$	= .428	$P.A.$ / —	.595
$\frac{H}{B}$	= .314	$D.A.$	
		$T.S.$	13,330
$L.A.B.$	= 150.25	$P \times R$	3,762
$\frac{2L.A.B.}{H}$	= 31.35	$1 - S$	.79
		V	29.33
$B.C.$ on $C - D$	= .345	$I.T._D$	11.77
$B.C.$ on $C - D$ cor. for $\frac{H}{B}$	= .271	$I.H.P.$	18,021
		$P.C.$	.525
		$E.H.P.$	9,461
		$S.H.P.$	15,680

$S.B.C.$ on X = .315

S = .21

$v_1 = 1.42\sqrt{300.5} = 24.75$

$v_2 = 1.92\sqrt{300.5} = 33.44$

$\frac{v_1}{V} = .85$

$\frac{v_2}{V} = 1.279$

Z_s taken on straight line passing over from $\frac{v_1}{V}$ on curve 1, Fig. 7, to $\frac{v_2}{V}$ on curve 2; where curve of $\frac{e.h.p.}{E.H.P.} - \frac{v}{V}$ crosses ordinate of unity load at lower than $\frac{v}{\sqrt{l}} = 1$ (Fig. 8), curve 2 becomes a horizontal line coinciding with $Z_s = 0$, Fig. 7. The change of the Z_s condition does not change so abruptly as is done in making the estimate, for

*Paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1920.

e. h. p.			$\frac{v}{V}$			S. H. P.d					Revs.	
$\frac{\text{e. h. p.}}{E.H.P.}$	e. h. p.	v		Zp	K	Est.	Act.	Zs	S	s	Est.	Act.
.025	237	10.3	.3512	—1.668	1	356	400	+1.215	.21	.074	165	160
.05	474	12	.4092	—1.355	1	732	720	+1.025	.21	.09823	197.3	200
.075	711	14.3	.4877	—1.1715	1	1,117	1,150	+ .805	.21	.09093	233.3	230
.10	946	15.52	.5292	—1.0414	1	1,507	1,500	+ .70	.21	.09568	254.5	252
.20	1,892	19.25	.6564	— .7279	1	3,102	3,100	+ .435	.21	.1070	319.7	317
.30	2,838	21.5	.7332	— .5445	1	4,732	4,750	+ .30	.21	.1196	362.1	359
.40	3,785	22.8	.7775	— .4144	1	6,385	6,300	+ .248	.21	.1432	394.6	394
.50	4,730	24	.8184	— .3135	1	8,055	8,100	+ 1.65	.21	.1492	418.3	425
.60	5,676	25.1	.8559	— .231	1	9,741	9,700	+ .122	.21	.1634	444.9	453
.70	6,623	26.15	.8917	— .1613	1	11,436	11,500	+ .105	.21	.1845	475.5	476
.80	7,570	27.15	.9258	— .1009	1	13,143	13,100	+ .095	.21	.2072	507.8	508
.90	8,514	28.15	.9599	— .0477	1	14,855	14,900	+ .08	.21	.2227	540.5	538
1.00	9,461	29.2	.9957	0.0	1	16,580	16,550	+ .061	.21	.2417	571	571
1.05	9,935	29.94	1.021	+0.0221	1	17,445	17,400	+ .05	.21	.2479	590.3	591

inspection of the actual revolutions indicates that it begins at about 23 knots and changes gradually until at 26 knots it has taken its position on the pass-over line used in the estimate.

Cavitation When $\frac{e.h.p.}{E.H.P.}$ Is Greater Than Unity

When the load fraction exceeds unity the laws governing the action of the propeller, both as to power and apparent slip increments, appear to change, but the changes occurring appear to be dependent upon the value of the speed fraction at which the performance plots on Fig. 8 (see page 402, May issue).

Should the performance plot on or above the curve E, Fig. 8, and at a load fraction exceeding unity, the values of Z_p follow the curve marked 5 on Fig. 7, while should it plot below the curve E the value Z_p follows the curve 4, the equation for curve 4 being

$$Z_p = 1.0414 \log \left(\frac{e.h.p.}{E.H.P.} \right)$$

while that for curve 5 is

$$Z_p = 1.51 \log \frac{e.h.p.}{E.H.P.}$$

Should the performance plot above E, the values of Z_s follow the curve 3, which differs slightly in equation from the cavitation curve 2, Fig. 7, the new equation being

$$Z_s = 3 \log \left(\frac{v}{V} \right)$$

Should it plot below E, the values of Z_s for values of $\frac{v}{V}$ greater than .9385, becomes zero, the increase in apparent slips being apparently independent of speed but entirely dependent upon power.

Performances of Four Vessels Analyzed

In order to illustrate these phenomena the performances of four vessels will be analyzed, the first, vessel H, having been used in the preparation of all the design curves; vessel I, a reciprocating engine destroyer plotting above E; vessel J, a destroyer plotting below E; vessel K, a dreadnought plotting below E.

The trial data of vessels I and J are not of the best, as the propellers of I were cavitating heavily, producing excessive vibration of the engines and affecting the clearness of the indicator cards, while with vessel J the starboard propeller and torsion meter readings suffered badly through induced cavitation of that propeller, the port propeller running smoothly.

Vessel H—Type 1

Hull		*Propeller*	
$L.L.W.L.$	= *	Number	2
B	= *	Blades	3
H	= *	Form	Standard
$B \div L.L.W.L.$	= .167	D	18.25′
Nom. $B.C.$	= .6	P	19.75′
$B.C.$ on $C - D$	= .572	$P.A. \div D.A.$	.328
$\frac{H}{B}$	= .317	$T.S.$	7,250
$B.C.$ on $C - D$ cor. for $\frac{H}{B}$	= .492	$P \times R$	2,498
		$1 - S$	8.65
		V	21.32
		$I.T.D.$	4.35
		$I.H.P.$	24,800
		$P.C.$	.665
		$E.H.P.$	16,492
Slip $B.C.$ on X	= .525		
$L.A.B.$	= *		
$2L.A.B. \div H$	= 18.88		
S	= .135		
K	= 1		

*The data omitted are confidential and therefore cannot be made public.

e. h. p.			$\frac{v}{V}$		I. H. P.d					Revs.	
E.H.P.	e. h. p.	v		Zp	Est.	Act.	Zs	S	s	Est.	Act.
.0747	1232	9.5	.3896	—1.1718	1670	1600	+1.09	.135	.1118	49.1	52
.09957	1642	10.45	.4902	—1.042	2251	2200	+ .8	.135	.07742	58.12	57.5
.1991	3284	13.21	.6196	— .728	4639	4800	+ .502	.135	.08023	73.69	73.6
.2987	4926	15.05	.7059	— .545	7054	7125	+ .346	.135	.08538	84.43	84.5
.3983	6568	16.45	.7716	— .415	9538	9300	+ .235	.135	.08919	92.66	92.5
.4978	8210	17.7	.8302	— .314	12035	11600	+ .145	.135	.09148	99.96	99.75
.5974	9852	18.92	.8875	— .233	14503	14625	+ .07	.135	.09275	107	106.8
.697	11494	19.76	.9269	— .1615	17098	17200	+ .017	.135	.09679	112.3	112.1
.7965	13136	20.33	.9536	— .1012	19645	19600	+0	.135	.1069	116.8	116.2
.8961	14778	20.8	.9756	— .048	22205	22200	+0	.135	.1209	121.4	120.2
.9957	16420	21.24	.9963	— .001	24740	25200	+0	.135	.1347	125.9	124.8
1.045	17230	21.44	1.006	+ .0294*	26537	26600	+ .015	.135	.1396	127.9	126.5
1.095	18062	21.62	1.014	+ .056*	28213	28100	+ .023	.135	.1457	129.9	129.2

The next vessel given is extremely interesting on account of the enormous range of load fraction and large range of speed fraction through which the performance extends.

Vessel I—Type 2

Hull		*Propeller*	
$L.L.W.L.$	= 245′	Number	2
B	= 23.52′	Blades	3
H	= 6.687′	Form	Standard
$B \div L.L.W.L.$	= .096	D	7.42′
Nom. $B.C.$	= .41	P	10.833′
$B.C.$ on $C - D$	= .332	$P.A. \div D.A.$	.275
$H \div B$	= .284	$T.S.$	6,400

B.C. on *C — D* cor.	
$\frac{H}{B}$ for	= .247
S.B.C. on *X*	= .295
2L.A.B.	= 245
2L.A.B. ÷ *H*	= 36.64
S	= .2225
P × *R*	2,974
1 — *S*	.7775
V	22.82
*I.T.*D	3.23
I.H.P.	3,625
P.C.	.693
E.H.P.	2,512

*In this case Z_p follows curve 5, Fig. 7, and Z_s follows curve 3.

sequent reduction of pressure occurs an increase in wake over the normal is generally encountered, resulting in a slowing down of actual revolutions below the estimate. The tip speed of the propeller at 35 knots was 16,050 feet with an effective thrust per square inch of projected area of 16.9 pounds, both figures being exceptionally high.

VESSEL K

This vessel is of the dreadnought type and has propellers of such characteristics as to plot her performance considerably below curve *B*, Fig. 8. Her hull is of type 1.

Hull		*Propeller*	
L.L.W.L.	= *	Number	4
B	= *	Blades	3
H	= *	Form	Standard
B ÷ *L.L.W.L.*	= .168	*D*	9.583′
Nom. *B.C.*	= .622	*P*	8.193′
B.C. on *C — D*	= .586	*P.A.* ÷ *D.A.*	.501
H ÷ *B*	= .305	*T.S.*	10,670
B.C. on *C — D* cor.		*P* × *R*	2,904
$\frac{H}{B}$ for	= .455	1 — *S*	.84
S.B.C. on *X*	= .49	*V*	24.13
2L.A.B. ÷ *H*	= 19.5	*I.T.*D	8.75
S	= .16	*I.H.P.*	31,732
K.B.C.	= .612	*P.C.*	.554
Mean *T.C.*	= Large	*E.H.P.*	17,580
K	= 1	*S.H.P.*	29,196

* The data omitted are confidential and therefore cannot be made public.

Concerning the efficiency of propulsion, results of trials indicate that with type 1 and probably very fine type 3 ships, where the basic slip is greater than the *S* values corresponding to curve *B*, Fig. 8, there is a gradual increase in efficiency in passing from the upper curve of *S* to *B* and then a gradual decrease until the cavitating curve for the basic *S* is reached. However, in making the estimates of performance this probable increase should be omitted and carried as so much possible velvet. The maximum gain is probably reached with basic slip between 21 and 22 percent, becoming practically zero with those basic slips for which the upper *S* curves on Fig. 8 approximate closely to *B* or are below *B*.

WAKE GAIN AND LOSS

Before taking up the subject of design there is one phenomenon met with to which attention should be called, and this is the effect produced by a change of wake which may occur due to the vessel altering her lines of flotation. This variation of wake may be due to a change in trim, causing

	v	e. h. p.	I. H. P.a		VESSEL H—TYPE 1			Revs.	
v	*V*	e. h. p. / E. H. P.	*Zp*	Est.	Act.	*Zs*	*S*	*s*	Est.	Act.
16	.7013	467 / .1859	—.762	627	....	+.35	.2225	.08617	163.8	...
18	.789	787 / .3133	—.522	1090	....	+.21	.2225	.1085	188.9	184
20	.8767	1287 / .5123	—.298	1825	....	+.082	.2225	.1353	216.4	220
22	.9643	1978 / .7874	—.105	2847	2750	+.0	.2225	.1747	249.4	255
24	1.052	2881 / 1.147	+.09	4460	4500	—.07	.2225	.233	292.6	296.5
25	1.096	3297 / 1.313	+.18	5487	5500	—.122	.2225	.2543	313.6	313.5
26	1.14	3738 / 1.488	+.26	6597	6500	—.178	.2225	.2687	332.6	324
27	1.184	4193 / 1.669	+.34	7931	7600	—.226	.2225	.2893	355.4	342
28	1.227	4474 / 1.781	+.38	8696	8750	—.278	.2225	.2814	364.5	368
28.5	1.249	4622 / 1.84	+.4	9106	9300	—.3	.2225	.2801	370.3	374

The performance of this vessel's propellers enters the overload zone to a greater extent than any other of which the records are available. The maximum load fraction attained is 1.84, while the corresponding speed fraction is 1.249. The ratio *S.H.P.* = .92 *I.H.P.* probably does not exactly fit this case, as the main air pumps were driven by the main propelling engines and absorbed some of the power developed by those engines.

VESSEL J

This vessel is a destroyer fitted with turbines connected directly to the propeller shafts. The revolutions are high with resultant high tip speeds, while the effective thrusts delivered at 35 knots were also very high. The blades of the starboard propeller had been injured by striking something and were run in this injured condition, with the result that the performance of this propeller was extremely erratic. The port propeller, however, ran smoothly to the end of the trials and the power data taken from this shaft were consistent. In comparing the estimated and actual performances the actual power of the port shaft has been doubled for the total power, while the revolutions of that shaft have been taken as the normal revolutions.

Hull		*Propeller*	
L.L.W.L.	= 310′	Number	2
B	= 30.7′	Blades	3
H	= 9.146′	Form	Standard
B ÷ *L.L.W.L.*	= .99	*D*	7.8′
Nom. *B.C.*	= .476	*P*	7.42′
H ÷ *B*	= .298	*P.A.* ÷ *D.A.*	.648
S.B.C. on *X* (cor.)	= .285	*T.S.*	15,100
2L.A.B. ÷ *H*	= 33.89	*P* × *R*	4,572
S	= .222	1 — *S*	.778
		V	35.11
		*I.T.*D	13.65
		I.H.P.	26,025
		P.C.	.525
		E.H.P.	13,663
		S.H.P.	23,943

		v	e. h. p.	ANALYSIS S. H. P.d							Rs	
v	e. h. p.	*V*	E. H. P.	*Zp*	*K*	Est.	Act.	*Zs*	*S*	*s*	Est.	Act.
12	430	.3418	.03147	—1.53	1	707	800	+1.255	.222	.1179	185.7	184
16	1050	.4558	.07685	—1.14	1	1735	1800	+ .894	.222	.1260	249.9	249.9
20	2210	.5697	.1618	— .82	1	3624	3900	+ .62	.222	.1401	317.4	310
24	4700	.6837	.3440	— .481	1	7910	8300	+ .388	.222	.1792	399.1	389
28	8600	.7976	.6294	— .205	1	14934	15000	+ .2	.222	.2195	489.6	468
32	12970	.9115	.9493	— .0221	1	22755	23000	+ .032	.222	.2271	565.1	563
34	15100	.9685	1.105	+ .0632	1	27695	27500	+ .0	.222	.2594	626.6	623
35	16200	.997	1.186	+ .80	1	28953	29400	+ .0	.222	.2669	652	655

These vessels begin squatting at about 20 knots, and when the struts are properly located so that no eddying with con-

ANALYSIS

e. h. p. / E. H. P.	e. h. p.	v	$\frac{v}{\sqrt{V}}$	Zp	K	S. H. P.$_a$ Est.	S. H. P.$_a$ Act.	Zs	S	s	Revs. Est.	Revs. Act.
.1	1758	10.31	.4273	—1.0414	1.0	2654	2750	.98	.16	.139	148	153
.2	3516	12.96	.5371	— .7279	1.0	5463	5400	.68	.16	.143	187	189.5
.3	5274	14.81	.6138	— .5445	1.0	8333	8100	.515	.16	.149	215	218
.4	7032	16.3	.6755	— .4144	1.0	11244	11050	.400	.16	.158	240	241
.5	8790	17.44	.7228	— .3135	1.0	14185	13700	.317	.16	.161	257	259
.6	10548	18.42	.7634	— .231	1.0	17152	16300	.250	.16	.167	274	274.5
.7	12306	19.32	.8007	— .1613	1.0	20138	19150	.19	.16	.171	288	288.5
.8	14064	20.1	.8350	— .1009	1.0	23143	22000	.142	.16	.176	302	302.5
.9	15822	20.7	.8579	— .0477	1.0	26159	25300	.11	.16	.185	314	315
1.0	17580	21.13	.8757	— .00	1.0	29196	28300	.082	.16	.193	324	326
1.05	18459	21.3	.8848	+ .0221	1.0	30720	30000	.075	.16	.200	329	331.5

an increase in wake during a portion of her career, but the wake usually returning to normal after an upper limiting speed is attained, or it may be caused by the vessel lifting bodily in the water, decreasing its submerged fullness and tending to plane. This latter action is accompanied by a heavy decrease in wake and a corresponding falling off in efficiency in propulsion.

EFFECT OF ALTERED TRIM

Vessels which slightly alter their trim at a speed depending upon the ratio of v to $\sqrt{L.L.W.L.}$ may accomplish this change in trim without an increase in the wake. Such a vessel is vessel *H*, while another ship of similar type may show a decided gain in efficiency during this period of increased wake due to the resulting increased thrust of the propeller produced by the increase in wake. Such a gain is spoken of as wake gain. Such gain is shown by vessel *L*, following. Vessels *H* and *L* have effective horsepower curves practically identical in form. Both show a slight hump between 15 and 17 knots. The performances on trial of the two ships were radically different. The writer was aboard both of these vessels and noted that vessel *H*, which was the lighter and smaller of the two ships, after passing 15 knots developed a very peculiar vertical vibration which gave one the impression that she was trying to break her back. This vibration disappeared after passing 17 knots. Vessel *L*, on the contrary, passed through the range of the hump smoothly and with a total lack of this peculiarity of vibration. Analysis of the performance of vessel *L* shows that when the estimate of power and revolutions are made for the speeds and effective horsepowers obtained from the model tank the revolutions obtained agree with the revolutions corresponding to the actual speeds corresponding to these estimated powers.

When a vessel lifts bodily in the water and begins planing as she lifts, the model tank curves indicate a rapid decrease in the increment of increase of the resistance. Should the estimate of power required be made for the *e.h.p.* and speed given on this curve of deflection, a bitter disappointment will be encountered. Rather, the curve before inflection should be extended by means of a batten and the v's corresponding to this extended curve of *e.h.p.* will be the actual speeds obtained by using the model tank curve of *e.h.p.* and v. After planing is accomplished the wake gradually increases to normal as the speed is increased.

Gain by possible wake increase should never be counted on as a certainty, but loss by wake decrease should always be allowed for.

VESSEL L

In the case of this vessel, the estimated powers and revolutions are those obtained from the model tank curve, while there are also given columns of the actual *S.H.P.*$_a$, speeds with corresponding revolutions obtained by fairing the hump out of the model tank curve and using the new speeds as those to be expected rather than those used in the estimate.

DESIGN OF THE PROPELLER

In treating this subject an attempt will be made to be as brief as possible, confining the discussion entirely to the precautions that must be taken in deciding upon the initial point of the design and to the formulas used in obtaining the design. This subject will be discussed in the fifth installment of this article, which will appear in the August issue.

CONDITION I

Hull		*Propeller*	
L.L.W.L.	= *	Number	4
B	= *	Blades	3
H	= *	Form	Standard
B ÷ *L.L.W.L.*	= .162	*D*	12.863′
Nom. *B.C.*	= .646	*P*	11.209′
B.C. on *C* — *D*	= .595	*P.A.* ÷ *D.A.*	.4247
H ÷ *B*	= .297	*T.S.*	9,000
B.C. on *C* — *D* cor.		*P* × *R*	2,502
H for $\frac{H}{B}$	= .455	1 — *S*	.865
S.B.C. on *X*	= .49	*V*	21.61
L.A.B.	= *	*I.T.D.*	6.62
2*L.A.B.* ÷ *H*	= 20.82	*I.H.P.*	37,404
S	= .135	*P. C.*	.603
M.T.C.	= Large	*E.H.P.*	22,556
K	= 1	*S.H.P.*	34,412

*The data omitted are confidential and therefore cannot be made public.

ANALYSIS

e. h. p. / E.H.P.	e. h. p.	v / tank	$\frac{v}{\sqrt{V}}$	Zp	K	S.H.P.$_a$	v_1 faired	S.H.P.$_d$ for v_1	Zs	S	s	R_d Est.	R_d Act. for v_1
.1	2256	11	.5091	—1.0414	1	3128	11.25	3250	+ .75	.135	.069	106.8	102
.2	4512	13.86	.6415	— .7279	1	6439	14.0	6550	+ .46	.135	.0729	135	129.6
.3	6768	15.75	.729	— .5445	1	9822	16.12	8950	+ .305	.135	.0778	154.4	151.3
.4	9024	17.25	.7984	— .4144	1	13253	17.67	13200	+ .198	.135	.082	169.9	168
.5	11280	18.4	.8517	— .3135	1	16719	18.8	16750	+ .118	.135	.0861	182	181.7
.6	13536	19.3	.8933	— .231	1	20217	19.7	20300	+ .061	.135	.0913	192	190.6
.7	15788	20.05	.928	— .1613	1	23736	20.34	23700	+ .015	.135	.0964	200.6	198.6
.8	18048	20.7	.9581	— .1009	1	27278	20.85	27250	0	.135	.107	209.6	206
.6	20304	21.15	.9789	— .0477	1	30833	21.25	31100	0	.135	.1131	215.6	213.5
1.0	22556	21.45	.9928	0	1	34412	21.55	Off curve	0	.135	.135	224.2	221

(To be continued.)

Balsa Insulation for Refrigerator Ships

Overcomes Many Difficulties in Installation and Maintenance of Refrigerated Spaces—Standard Insulation Plans

INSULATION that is adequate and economical in operation and practical from the viewpoint of the shipbuilder and the shipowner is one of the most important factors in the development of refrigerator ship cargo capacity for the transportation both of fruits and of the more highly perishable meat and dairy products.

In the fruit trade there are several interesting developments along new lines, the more important being the movement of Pacific Coast fruits to the Atlantic via the Panama Canal. Heretofore practically all of this tonnage has moved overland but the burden of greatly increased freight rates and the improved service by water in point of time and frequency of sailing are responsible for the recent experimental shipments of citrus fruits and apples by water. The fruit growers are now carefully studying various methods of insulation and refrigeration in co-operation with the Department of Agriculture. Projects are also under consideration for the movement of fancy fruits from the west coast of South America to the United States.

With the exception of the fruit trade, both existing and under development, the United States, though the largest producer of foodstuffs in the world, has not felt the necessity of having refrigerator ships to carry abroad its surplus of perishable meat and dairy products. This condition may partly arise from what is apparently the belief of ship operators that refrigerated ships are undesirable from the viewpoint of maintenance and upkeep and that they are not adaptable to general cargoes on the return hauls; despite the fact, too, that cargo carrying under refrigeration brings higher freights rates and permits of more complete service.

The demand for refrigerated cargo vessels divides between two principal groups of products—meats, requiring low temperatures, and fruits, calling for temperatures of 35 to 50 degrees F. In the meat trade, home consumption demands have established England as the chief importer of frozen and chilled meat, to the extent that in 1913 that country took 94 percent of the total world tonnage of these products moving over seas. To bring these meats from her colonies and from South America, England has developed a great fleet of refrigerator vessels representing in 1920 about 75 percent of the total refrigerator ship capacity of the world. If the refrigerator space in the large passenger liners is excluded, English ships have over 90 percent of the world's refrigerated cargo capacity. This world capacity aggregated, in 1913, 53,000,000 cubic feet of cold storage space in ships having 10,000 or more cubic feet each, excluding the fruit carriers. By June, 1920, this figure had increased, almost proportionately with the increased meat trade, to 89,000,000 cubic feet, including the capacity of ships under construction.

The difficulties of maintenance and flexibility center largely around the problem of satisfactory insulation of the refrigerated spaces. That many of these difficulties can now be avoided through the use of Balsa insulation, gives promise of a more extended interest in this type of tonnage. For example, with the formerly accepted methods of insulation it was impossible to get at the shell of the vessel to locate and repair a leaking rivet without tearing out the insulation and having to patch it up one way or another afterwards. Or in such a case as a slight collision with the dock or tug boat nose, or other damage, the exact point which must be inspected is often difficult to locate and considerable areas must therefore be uncovered to find the exact location of the trouble, even though this may be quite small and trivial.

Another point in connection with many forms of insulation is that, while they are efficient when dry as first installed, they gradually absorb moisture and lose their insulating value or they may shake down under the vibration of the ship. Renewal expense is therefore a large item in these cases. Balsa thoroughly treated and waterproofed retains its insulating efficiency and its structure.

Balsa insulation, now in use on over sixty vessels and specified for another twenty odd under construction according to a tabulation prepared by American Balsa Company, Inc., is in distinct contrast with other insulating materials. Probably the most important development in the use of Balsa is the plan of installation which permits the ready removal of entire sections of the insulation for the repair or painting or simple inspection of the ship's hull. These sections can quickly be lifted back into place without sacrifice to the insulating efficiency of the structure and without any waste of material. The importance of this plan will at once be appreciated.

Other factors such as durability and permanence, high insulating quality, ease of installation and saving of space and weight make a consideration of Balsa of interest. Equally, too, does the present extension of its use to the insulation of boiler and engine room casings, crew's quarters and for partitions between staterooms.

Balsa is the lightest weight wood known to commerce, averaging in its treated condition about ten pounds per cubic foot, or roughly, one-third less than cork. Individual pieces of Balsa have been found weighing as little as four pounds per cubic foot. This lightness results from its peculiar cellular structure which is said to differ from that of any other wood. In ordinary wood the thickness of the cell walls forms a considerable part of their diameter. In Balsa these walls are extremely thin and, where in other woods these are woody fibers, there is in Balsa practically no lignification. This structure confines within its large, barrel shaped cells a quantity of "dead" air, i.e. non-circulating air, representing over 90 percent of the total volume of the wood, accounting for its high insulating value.

In contrast with any other insulating material Balsa has the important and unique advantage of a structural strength which is fully half that of spruce. This strength of Balsa, together with its other advantages of woodworking facility, the large panels in which it is supplied, tight joints, non-absorption of moisture and permanence of structure, establish an entirely new basis for the installation of insulating material. Balsa panels are 24 inches wide, 8 feet to 10 feet in length and 1 inch, 2 inches and 3 inches in thickness. This large size is an important factor in the simplicity of its installation.

Irrespective of the coefficient of heat transmission of the insulating material, the refrigerating engineer has always found it necessary to allow an excessive margin for joint leakage because of the difficulty of securing tight joints under the conditions of commercial installation and because of the

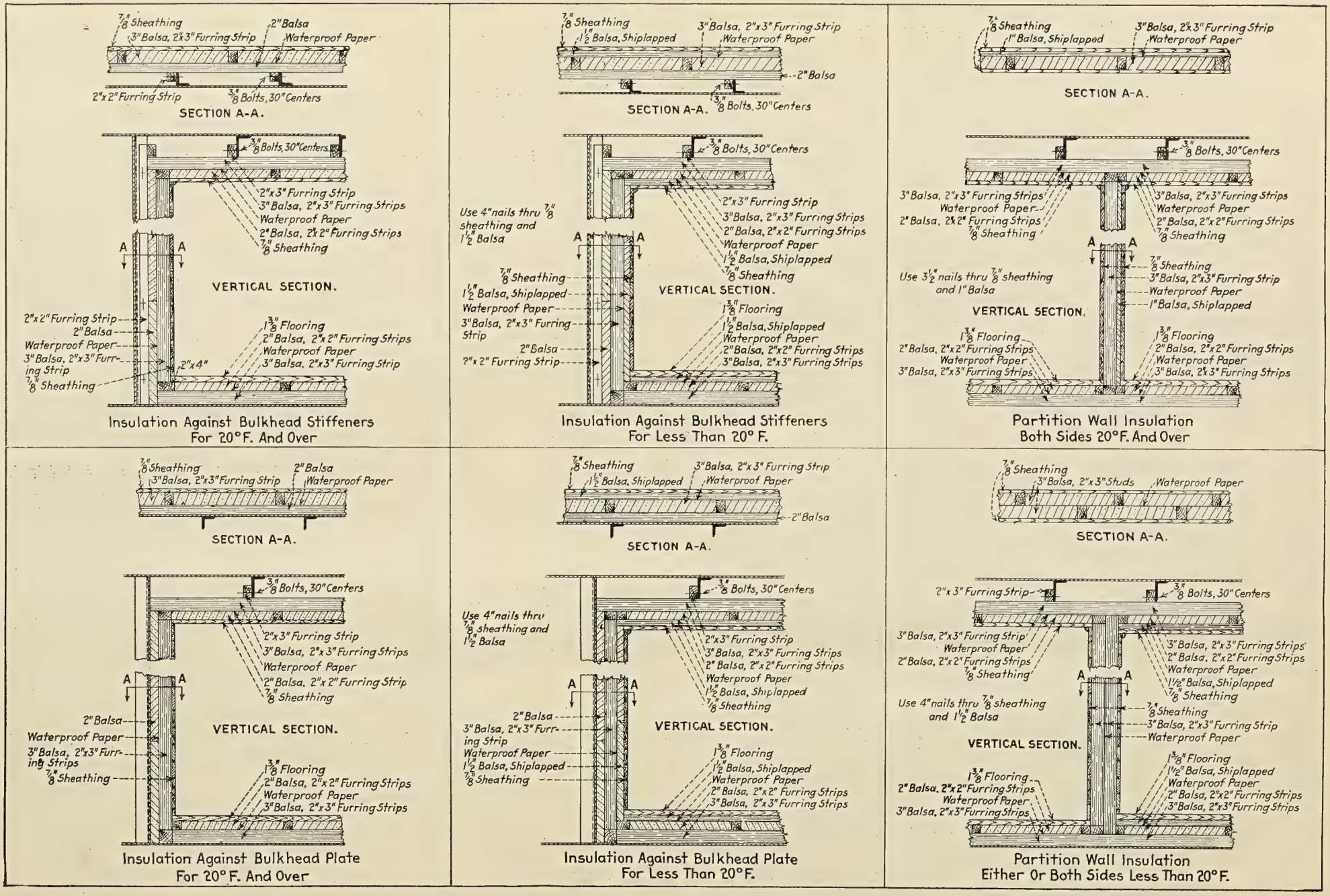


Fig. 1.—Standard Balsa Insulation Plans for Refrigeration

higher heat transmission of the cementing or filling materials that have ordinarily to be used. It is also necessary with other materials to compensate for loss of efficiency through moisture absorption.

Balsa, with a coefficient that compares favorably with other commercial materials, has the added advantage of very small joint leakage. This is due, first, to the smaller number of joints possible with the large panels and, second, to the close woodworking of the tongue and groove, ship lap or butt joints used and the elasticity of the wood which permits of very tight setting of these joints.

Another important factor resulting from the structural character of the Balsa panels is the elimination of most of the sheathing, studding and supporting structure required where other insulating materials are used. Instead of a large number of layers of waterproof paper, sheathing and framing necessary to support the insulating material proper, there is required with Balsa only one layer of sheathing for protection against surface wear.

This simplified construction represents an important

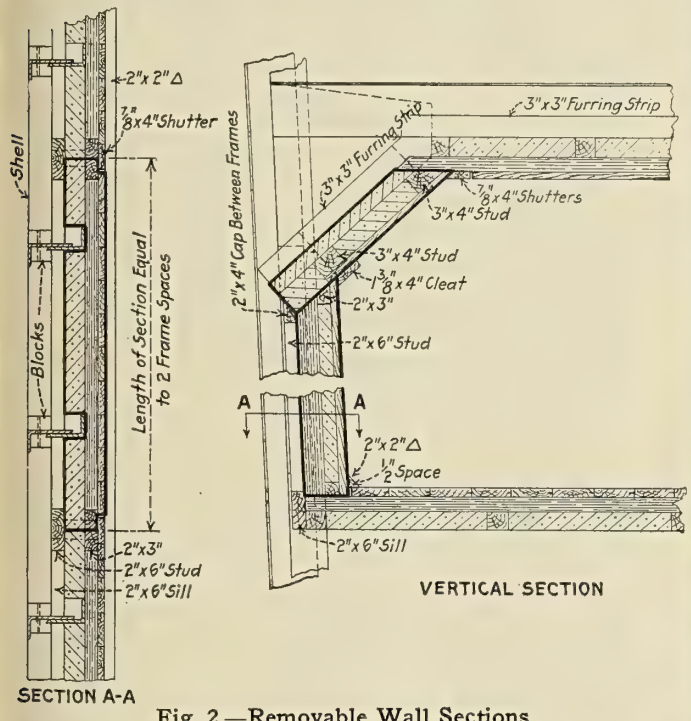


Fig. 2.—Removable Wall Sections

saving both in the cost of the accessory materials and in the labor of assembling; together with the light weight of the Balsa itself, it also materially reduces the deadweight which must be carried and the saving in total thickness of the insulation wall or floor means just so much greater revenue-producing storage capacity. For example, a completed insulation wall, using six inches of cork board with the required four layers of spruce sheathing, is 9 inches thick and weighs 17 pounds per square foot of wall area. Six inches of Balsa insulation, with the one protecting layer of spruce needed, is 7½ inches thick and weighs only 8 pounds per square foot, or less than half the weight.

One of the most important features of Balsa is the permanence of its structure and insulating value, achieved through special treatments to which the wood is subjected. It is by reason of these exclusive methods of treatment that the American Balsa Company has been successful in adapting this product of the tropical forests to the many practical commercial uses to which Balsa is being placed.

The processes of treatment expel all surplus moisture from the wood and preserve it against decay. In addition, the waterproofing treatment effectively prevents the absorption of moisture after installation. Balsa, therefore, is not subject to a reduction of insulating efficiency; and from the viewpoint of sanitation, this exclusion of moisture absorption by Balsa is a valuable feature through the prevention of odors arising from bacterial lodgment and growth.

By reason of its many desirable characteristics, Balsa is meeting successfully the problem of maintaining permanent insulating efficiency in refrigerated spaces on board ship. Where many other materials quickly deteriorate through the absorption of moisture and disintegrate or become dislocated through vibration, Balsa has been found to maintain its structure and efficiency even under the most unfavorable conditions.

STANDARD INSULATION PLANS

The extensive employment of Balsa as the insulating material for ships has led to the adoption of a series of standard plans of installation for different locations and different

Fig. 3.—Several Stages of the Installation of Balsa Ship Insulation in Refrigerated Cargo Hold of Passenger and Cargo Liner

types of ship construction and for temperatures above or below 20 degrees F. Where abnormal conditions prevail these plans can easily be modified. Sketches of these plans are shown in Figs. 2-7, which indicate the simplicity of Balsa installation. Standard instructions covering the details of erection have also been issued, which place the whole installation within the scope of ordinary joiner work.

Particular interest attaches to the plan of installation, already mentioned, by which the insulating walls can be removed to get at the shell of the ship. Heretofore, when it has been found necessary to paint or inspect the inside of the hull or to replace rivets, the insulating material has had to be torn out and, later, patched up at the expense of insulating efficiency and a great deal of labor.

REMOVABLE WALL SECTIONS

With the plan of Balsa insulation shown in Fig. 2, the removable wall sections are made of one layer of Balsa

panels erected vertically and another layer laid horizontally, enclosed in a hardwood frame to which the sheathing is applied vertically. These composite sections are held in place by fastening the frame to stationary studs with lag screws. The heads of the screws are covered by a 4 inch shutter of the sheathing material running the length of the joint. Under this plan of construction there is a continuous layer of the insulating material, a most important factor in efficient insulation. Furthermore, all of the joints surrounding the removable section are broken, thereby preventing air leakage.

To take out any section of the Balsa removable insulation the shutter on each side of the section and the top and bottom cleats are removed, the screws taken out and the Balsa wall allowed to swing down on to the floor.

This plan of removable Balsa sections can be applied to insulation either between frames or inboard of the framing. The additional space gained by inserting one of the layers of the Balsa wall section between the frames is an important factor in increasing the carrying capacity of the refrigerated space.

Balsa has also been used for a number of years in ships' ice boxes where its structure and insulating efficiency permits the construction of boxes to be placed anywhere, even exposed on deck. On ships where there is no refrigerating mechanism the saving in ice and the preservation of perishable food during long voyages are important factors favoring the use of Balsa.

FIRE PROTECTION OF INSULATED SPACES

In fire resisting qualities Balsa compares favorably with other insulating materials. Tests show an exceedingly slow flame penetration, due to the insulation action of the first surface charring. Balsa will not continue to glow or smolder, thereby greatly reducing the fire risk and eliminating those fires that have in the past been found almost impossible to extinguish where insulating materials have smoldered, with noxious gases, for days at a time. Another factor in the fire resistance of Balsa is the fireproof character of the waterproofing compound used on the Balsa panels, which contains a chemical well known as a constituent of fire extinguisher fillings. Lloyds and the American Bureau of Shipping have approved the use of Balsa for ships' insulation.

Further advantage that has been taken of the structure and high insulating value of Balsa is its use for the insulation of boiler and engine room casings and for the floors of crew quarters where, as on tankers, these are located over the boiler room. Where it is desired to install the Balsa panels on the inside of the casings, and for floor use, these panels are sheathed with sheet metal on one side which affords protection against wear and added resistance to fire. A number of such installations have already been made and others are in progress of construction. The additional comfort to passengers and crews resulting from the increasing use of Balsa for these purposes can be appreciated, especially by those who operate ships in the tropics.

Not only in ships but in many other phases of the transportation of perishable products, Balsa has begun to play a conspicuous part. Extensive test installations of this material as the insulation for refrigerator cars and automobile trucks show remarkable results in insulating efficiency and in the lessening of the weight of the carrier, with an increase in strength and permanence of structure.

Though refrigerator ships hitherto have been an unimportant factor in the American merchant marine, there are indications of an awakening interest in this type of tonnage. According to listings of April, 1921, the United States has only eighteen straight refrigerator ships, with a total of three and one-half million cubic feet capacity, consisting largely of refrigerator ships ordered by the government during the war. While this is entirely disproportionate to the greatly increased merchant tonnage of the United States, there are in addition to these vessels a number of ships engaged in the transportation of fruit, of which the outstanding example is the "great white fleet" of the United Fruit Company, whose refrigerated spaces aggregate about 5,000,000 cubic feet. Practically all of these fruit vessels were built in England.

As the material for the construction of containers for shipment of perishables by parcel post or express, Balsa, through its structural strength and woodworking facility, is opening up an entirely new transportation development. Ice cream, meat, fish, poultry and other products, chilled and packed in chilled Balsa containers, can be transported for great distances in excellent condition without further refrigeration. In addition to the lighter weight of the containers the elimination of the ice formerly required for packing materially decreases the shipping costs.

With the extension of these important and varied uses, Balsa may well lead to the development of adequate refrigerated cargo space and to the prevention of much of the waste now suffered in the transportation and marketing of perishable foodstuffs.

Another Burden for Shipowners Proposed

(*Concluded from page* 512)

in the old days. Thus, the Steamboat Inspection Service is now costing the country a little more than $1,000,000 a year and there would have to be determined the question of whether the old fees, graded on a sliding scale, would be restored, or a new fee basis adopted to raise that sum.

A question that also looms large, if this proposition is to be seriously taken up, is the treatment to be accorded vessels owned by the Government. The feeling of Secretary Hoover is that vessels engaged in the Government service should be inspected, licensed, etc., without payment of fees, but that this free service should not extend to the vessels owned by the Shipping Board Emergency Fleet Corporation. It is estimated that the bona-fide government vessels, such as the vessels of the Mississippi River Commission, the craft of the Quartermaster's Department of the War Department, etc., would not represent more than 5 percent of the total inspections.

Included in the Department of Commerce, and the object of especial solicitude on the part of the new Secretary, is the Bureau of Foreign and Domestic Commerce. It is via this institution that Secretary Hoover hopes to make investigations of port storage and harbor transfer conditions, etc., that should prove ultimately of distinct benefit to the shipping interests of the country as a whole. By this same instrumentality, also, Secretary Hoover plans an intensive study of the whole broad subject of "trade routes," a matter of the utmost importance at this juncture to shipping men no less than to shippers.

In connection with the Bureau of Foreign and Domestic Commerce it is gratifying to note that Congress has granted the additional appropriation that Secretary Hoover requested as necessary to efficiently carry on the work of this bureau. A large number of business men wrote personal letters to congressmen endorsing Mr. Hoover's request for this appropriation.

One of the most interesting responsibilities that devolves upon the Commerce Department under the administration of Secretary Hoover consists of the distribution of medals of merit to the merchant marine in accordance with the provisions of the law with which our readers are doubtless familiar. The act of Congress provided for the conferring of the medals during the war period, with a period of three years allowed for the actual distribution. Congress has been asked for an appropriation of some thousands of dollars to provide the authorized medals.

In figuring on the medals likely to be required, the Commerce Department officials have based their estimates primarily on the fact that there are in the merchant marine some 35,000 officers and men who were on vessels which were torpedoed. With this as a working basis, the Federal officials, in conjunction with the best-informed members of the shipowners' association at New York, have applied the law of averages and analyzed prospective ability to quality until they have arrived at the deduction that about 500 medals will probably be required. The awards will be made by a board of three to five men of standing in the shipping world.

American Passenger Liner George Washington

(*Concluded from page* 507)

and one of which was occupied by the King and Queen of Belgium during their respective voyages upon this vessel. These suites are located on *B* deck at the foot of the monumental stairway from the grand social hall and each consists of a living room, dining room, bedroom and bath. These suites are marked with silver plates giving the names of their former distinguished tenants with brief reference to their voyages and will be a natural center of attraction to all travelers on board the vessel. The suite on the port side, used by President Wilson and the King and Queen of Belgium when on the vessel, is constructed in veneers of mahogany and rosewood, inlaid with satin and other lighter woods and decorated with panels of raised plastic. Mahogany and rosewood have been used freely in the furniture and every effort has been made to hold the room intact, as used by the President, for its deep historical interest.

A replica of the desk upon which the President prepared his first drafts of the Peace Treaty stands in the Presidential suite in the exact position occupied by the original, which has been presented to the President by the Directors of the Company. The beds, dressing table, toilet receptacles, portable furniture, etc., are in woods matching with the panel work of the room and exhibit some of the finest cabinet making that can be produced in the United States.

The foyers and open spaces of the *B* deck are decorated in a Continental style.

The interior of the rooms and suites forward of the main monumental stairway are finished in the choicest of hardwoods with the most elaborate and painstaking cabinet inlay work that can be obtained. The curtains, upholstery, hangings, etc., are of corresponding style and finish and the portable furniture in the rooms designed and manufactured for their specific locations. Baths and toilet rooms are fitted with the most modern and complete plumbing and finished generally in enamel tile.

The decks of each of the suites and rooms on *B* deck are heavily carpeted and laid with oriental rugs of the choicer weaves.

Electric Baths and Gymnasium

There are also upon *B* deck the electric baths with their adjacent massage rooms, showers and dressing rooms for the use of the passengers.

At the after end of the first class quarters on this deck is also found the gymnasium which is properly and simply furnished in maple and equipped with the usual athletic apparatus, ladies' and gentlemen's dressing rooms and bath rooms.

Lower Decks

The bed rooms and sitting rooms on the lower decks are constructed generally in a manner equal to that on the upper decks but with a less elaborate scheme of decoration and finish. The general character of these rooms throughout the vessel, however, is one of quality and refinement, wherein workmanship and materials have been used with utmost discrimination to produce appropriate results.

Main Dining Saloon

The main dining saloon, with a seating capacity of approximately 350, is located in the center of the vessel upon the lower first class passenger deck or *D* deck. The saloon is exceptionally commodious with ample clearance spaces in way of tables and surmounted by a center dome reaching to the second deck above.

The room is designed and constructed in the Colonial and Georgian style and finished in cool shades of French gray. The decorations of the dome consist of Doric and Ionian columns with a well designed wrought iron rail on the level of the upper deck which presents a most satisfying appearance of grace and lightness. Buffets and service tables are situated at convenient points and large mirrors fitted in the fore and after wall panels add to the spaciousness of the entire room.

The upholstery and hangings of the room are in old rose and all side lights are fitted with inner sashes and draped with silk curtains in corresponding shades.

The choicest of linen, silver, china and glass have been obtained and when the room is set an appearance of charm and refinement results which satisfies the most fastidious of tastes.

The Children's Dining and Play Room

The children's dining and play room, which is adjacent to the main dining room has been laid out as one of the most delightful spaces on board the vessel.

It is finished in French gray and old rose upholstery and decorated with gaily colored prints of suitable character to appeal to this highly prized group of passengers.

Second Class Accommodations

There are accommodations for 442 second class passengers in spacious state rooms with dining rooms, smoking rooms, sitting and writing rooms, etc., in a proportionate degree of elaborateness and with ample deck space for promenade and games.

The arrangement of these spaces is such that there can be no feeling of discrimination upon the part of the passengers traveling in these quarters.

Foyers and public rooms of the second class accommodations have also been carefully and appropriately worked out by the decorating architect and, while in more simple lines and details than the first-class, still exhibit the workmanship of a true artist and fully satisfy the most exacting.

Third Class Accommodations

Third class passengers to the number of 1,485 are accommodated in rooms containing two, four and six berths or in open compartments as the individual traveler may select. As in the case of the other classes, these accommodations are made up in part of dining rooms, smoking rooms, writing rooms, etc., so that the traveler in this class, while having less space and comparatively limited luxuries, may find himself in perfect comfort and cleanliness with unlimited light, air, heat and all the necessities of ocean travel.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department

Conducted by James L. Bates

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Estimating the Painting of Ships

Q. (1125).—Can you inform me as to where I will find information relative to estimating for the painting of ships?

A. (1125).—It is assumed that your inquiry relates to the covering value of a given amount of paint, rather than to its cost, inasmuch as the cost would be dependent upon the conditions of the market, the character of paint, etc.

At once the most complete and most reliable information on this subject, with which the writer is familiar, is contained in the "General Instructions for Painting and Cementing Vessels of the United States Navy." A copy of this pamphlet may be obtained upon application to the Bureau of Construction and Repair, Navy Department, Washington, D. C.

In addition to regulations governing quality of material, mixture of ingredients, painting of surfaces, colors for different parts and types of ships, care and preservation of surfaces for varying conditions, use of cement, etc., this publication contains in tabular form, for some seventy-five different paint formulæ, the material, weight per gallon, spreading surface, ingredients, and quantities required for mixing various amounts.

In connection with the use of this information for purposes of estimating, attention is particularly invited to the following statement, which occurs in paragraph 63, page 37:

"The weights per gallon of paint and approximate area covered, as given in the following formulæ, are intended to be approximate only, these figures being dependent to a certain degree upon the materials used and the kind and condition of the surface to which the paint is applied."

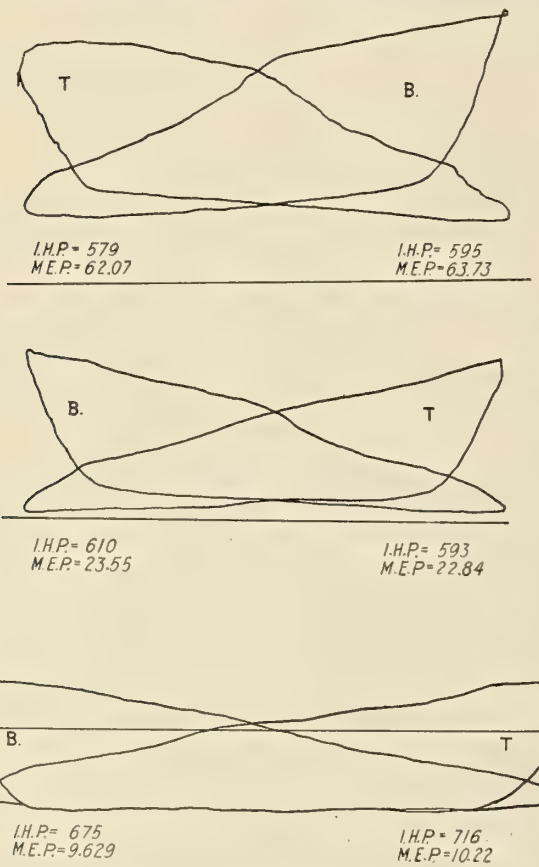
The values for spreading rate are generally based upon a metallic surface, but it will be readily appreciated that it is impossible to give a value which will be exact for even a metallic surface under all the various conditions which might obtain.

Engine Performance from Indicator Cards

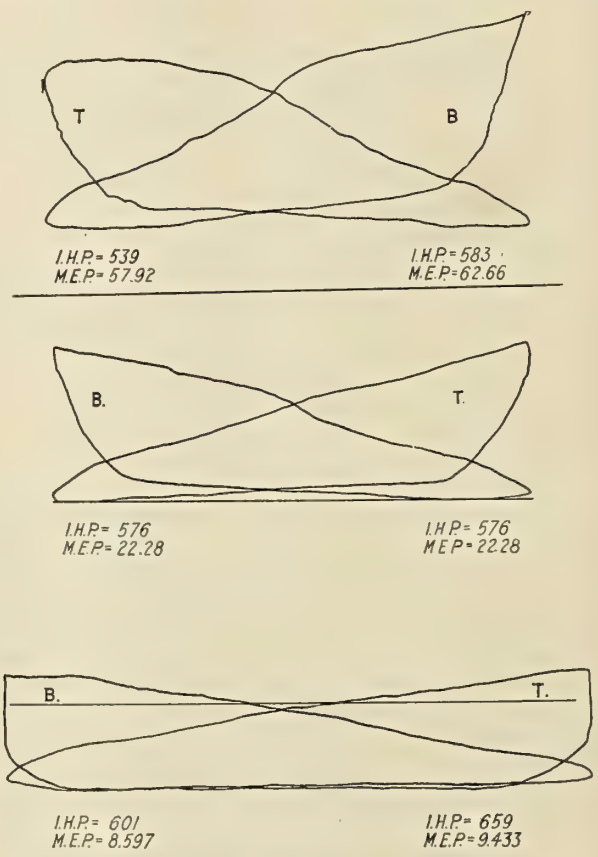
Q. (1121).—Please figure out and criticise the enclosed indicator cards. F. G. S.

A. (1121).—The loops at the top right side of the bottom high pressure cards indicate that the exhaust opening closes too soon, thus causing compression at the bottom end to begin too early, compressing up beyond the admission pressure, thus performing lost work.

The top left sides of the top high pressure cards show that



First Set of Indicator Cards



Second Set of Indicator Cards

compression at the top end begins too late. When the piston starts its return stroke the pressure at once begins to drop; then admission takes place, causing the line to rise, a loop of negative work resulting.

To remedy this fault, move the valve along the valve stem in such a direction as to produce a later compression on the bottom end, which in turn will cause an earlier admission on the top end.

The intermediate and low pressure cards seem to indicate satisfactory setting.

The summary of mean effective pressures and indicated horsepowers follows:

MEAN EFFECTIVE PRESSURE

Set	H. P. Top	H. P. Bottom	I. P. Top	I. P. Bottom	L. P. Top	L. P. Bottom
First	62.07	63.73	22.84	23.55	10.22	9,629
Second	57.92	62.66	22.28	22.28	9.433	8.597

INDICATED HORSEPOWER

Set	H. P. Top	H. P. Bottom	I. P. Top	I. P. Bottom	L. P. Top	L. P. Bottom	Total
First	579	595	593	610	716	675	3,768
Second	539	583	576	576	659	601	3,534

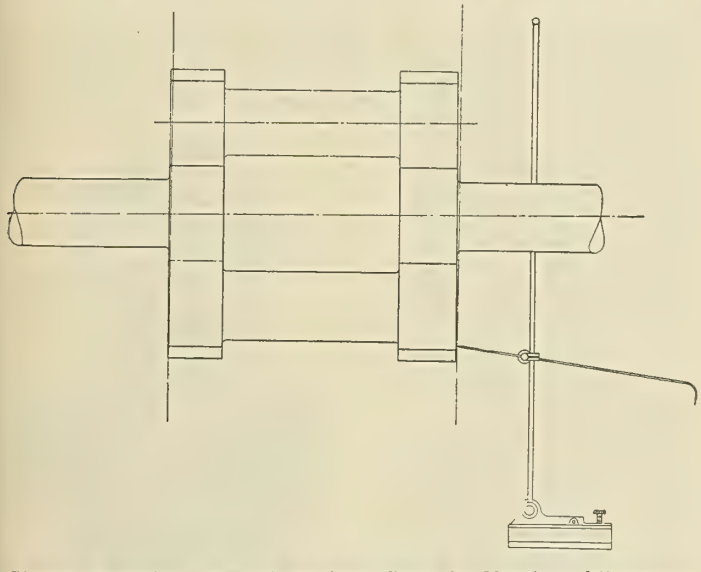
Diameter of piston rod not given and therefore neglected.

Lining Up Inclined Paddle Wheel Engines

Q. (1124).—On a vessel fitted with a pair of 17-inch by 72-inch paddle wheel engines resting on wooden framing foundations which have been running over 14 years there are indications that the cylinders have dropped down out of their original alinement. The main shafting, also a part of the crankshaft, is placed just beneath the main deck and thus becomes exceedingly unhandy to remove, as could be done conveniently in most screw vessels. Is there any method that could be used to test out or readjust their alinement without removing the crankshaft? A. H. C.

A. (1124).—Your question was taken up with two engineers of prominence and experience. Their suggestions are quoted below:

(a) Stretch two wires parallel with the shaft, one of the wires being in a horizontal plane containing the center of the



Sketch Showing Use of Surface Gage in Testing Alinement of Engine

shaft and the other wire being in a vertical plane containing the center of the shaft, then place the wires at a distance from the shaft so that it would be possible to get a straight passage for them. By measuring from the wire in the vertical plane to the shaft at various spots, the shaft can be made parallel to the wire and hence straight; by measuring to the wire in the horizontal plane, the shaft can be made parallel to that wire and hence straight in that plane. As these two planes are at right angles to each other or as near to right angles as circumstances will permit, the shaft which lies in both of the planes will be straight. The alinement of the cylinders, crossheads, guides, etc., presents no difficulties because the piston rods and connecting rods can be removed and the job lined in the usual way.

(b) Start by first placing the crank on the bottom center. By this I do not mean at the end of the stroke but on the quarter which would bring the crank at its lowest point with the piston half way of the cylinder. I would then find a definite point of contact either by surface gage, plumb line or straight edge and then turn the crank over to the exact opposite point or upper position. The difference as shown by the sketch would be the amount the engine was out of alinement. The line as shown in the sketch is the true position and the crank as shown is out of position.

(c) A quicker way would be to secure the crosshead and then center the wrist-pin brasses and secure them so that they cannot move. Then follow up to the crankpin and see that the crankpin brasses have an equal clearance on each side of the crank. Then turn this to the opposite position and see if the same results are obtained.

Either one of the two methods should be sufficient to give the information unless it is desired to strip the engine, taking out the pistons and running a line through the cylinder, through the center of the crosshead and up through to the crankpin.

Packing Pipe Joints

Q. (1127).—I would appreciate it if you would send any information, data or results of experiments on packing of the order shown in Figs. 1 and 2 for heavy and light pressures. I am especially interested in the material and best sections of light packing for gasoline, oil, etc.

A. (1127).—The best compilation of information relating to the above subject, with which the writer is familiar, is contained in "Instructions for Making Joints and Obtaining Watertightness and Oiltightness," General Specifications—Appendix 9—issued by the Navy Department, Bureau of Construction and Repair and Bureau of Engineering.

Certain large private shipbuilding yards make up joints for oiltightness in pipe lines either between flange and flange

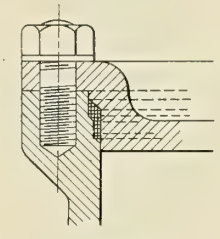


FIG. 1.

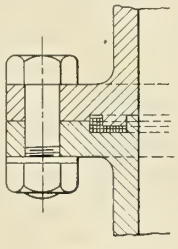
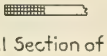


FIG. 2.

Original Section of Packing.



Original Section of Packing.

or between flange and structural members with trunk board gaskets. If the trunk board is dipped in water for a short time only (generally less than a minute) before it is placed in position, the joint makes up thoroughly tight and gives a good account of itself in service.

Joints of 8-inch pipe made up with this material as described above have been tested with oil under pressures of 26 pounds per square inch for 24-hour periods and found perfectly tight. A joint (flange to flange) in a 2-inch pipe line fitted with a trunk board gasket dipped in water about one minute before placing in position satisfactorily withstood an air test of 250 pounds per square inch.

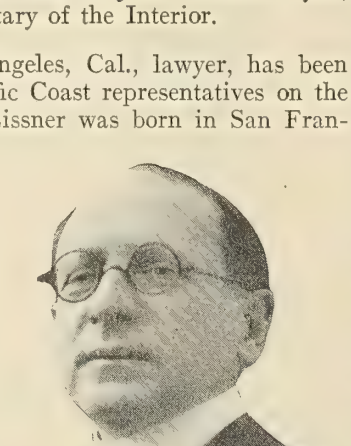
Trunk board is made by mixing with sizing either raw paper pulp or refuse, such as sweepings, trimmings, etc., of paper products and compressing same into sheets under a very high pressure. Manila paper painted with shellac is also used in the joints of oil systems and this may be more convenient in certain cases.

PERSONAL MENTION

REAR ADMIRAL W. S. BENSON, U. S. N. (retired), former chairman of the United States Shipping Board, has been appointed one of the Atlantic Coast representatives on the new Shipping Board. Born in Bibb county, Georgia, in 1855, Rear Admiral Benson was graduated from the Naval Academy in 1877. In 1879 he was promoted to the rank of midshipman and served on the U. S. S. *Constitution* for two years. In 1881 he was promoted to the rank of ensign, after which his promotions came in the following order: Lieutenant (Jr.), 1888; lieutenant commander, 1900; commander, 1905; captain, 1909; rear admiral, 1915; admiral (chief of naval operations), 1916. Admiral Benson has served as commanding officer of several of the first class dreadnoughts and at one time was chief of staff of the Pacific fleet. From 1907 to 1908 he served as commandant of midshipmen at the Naval Academy and was commandant of the Philadelphia Navy Yard and supervisor of the third, fourth and fifth naval districts from August, 1913, until April, 1915, when he was assigned to duty as chief of naval operations. In the latter part of 1917 he was assigned to temporary duty in London, after which he returned to the United States until he was ordered to special duty at Paris. He remained abroad until June 11, 1919. In the following year he was elected chairman of the Shipping Board for the unexpired term of John Barton Payne, who resigned to become Secretary of the Interior.

Rear-Admiral W. S. Benson

MEYER LISSNER, a Los Angeles, Cal., lawyer, has been appointed as one of the Pacific Coast representatives on the new Shipping Board. Mr. Lissner was born in San Francisco in 1871, received his education in the public schools at Oakland, Cal., and graduated in 1899 from the Los Angeles Law School. Since 1899 he has been engaged in the practice of law at Los Angeles. In 1907 Mr. Lissner organized the Los Angeles City Club and was its president in 1911. He was president of the Good Government Organization and chairman of the First Board of Public Utilities in Los Angeles in 1909. He was also active in organizing the reform movement in California in 1910 and was chairman of the State Central Committee in that year. Mr. Lissner has always maintained an active interest in California's public service and was a delegate to the National Committees in 1912 and 1920. From 1914 to 1918 he was editor of the *California Outlook* and from 1916 to 1920 a member of the California Industrial Accident Commission.

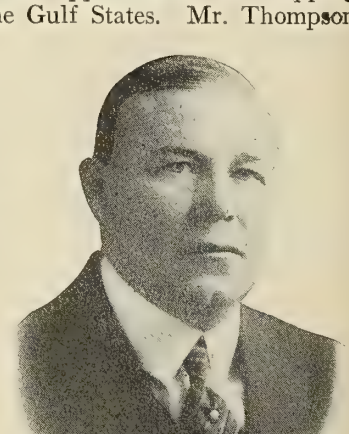


Meyer Lissner

THOMAS M. CORNBROOKS has been appointed assistant works manager of the New York Shipbuilding Corporation, Camden, N. J.

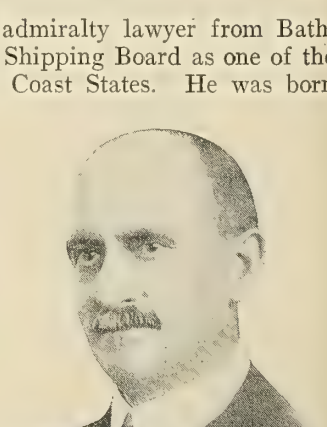
P. A. DEBUS, formerly connected with the Crescent Machine & Manufacturing Company, New Orleans, La., has been appointed general manager of the Jahncke Dry Dock & Repair Corporation, New Orleans, La.

FREDERICK I. THOMPSON, owner and publisher of the Mobile, Ala., *Register,* has been appointed to the Shipping Board as representative of the Gulf States. Mr. Thompson was a recess appointee to the Board under the Wilson administration, serving from December 1, 1920, to March 4, 1921; since that time he has remained in Washington as one of the trustees of the Emergency Fleet Corporation. Mr. Thompson has been in the newspaper and advertising business all of his life, starting with the Memphis *Commercial Appeal.* In 1900 he came to New York and for eight years was a member of the firm of Smith and Thompson, newspaper advertising representatives. He then went to Mobile and engaged in newspaper publishing where he became actively interested in the development of the Gulf ports, supporting the fight for the creation of the Alabama State Harbor Commission.



Frederick I. Thompson

EDWARD C. PLUMMER, an admiralty lawyer from Bath, Me., has been appointed to the Shipping Board as one of the representatives of the Atlantic Coast States. He was born in Freeport, Me., in 1863 and graduated from Bowdoin College in 1887. He began work as a reporter on the Bath *Daily Times* and in 1892 became proprietor and editor of the Bath *Independent.* In the course of his newspaper work Mr. Plummer became interested in shipping and when the Atlantic Carriers' Association was organized he became its first secretary and for 21 years has been active in its work. In recent years he has spent much time in Washington as the association's secretary and counsel and has appeared many times before Congressional committees investigating shipping matters.



E. C. Plummer

WILLIAM G. COXE, vice-president of the Pusey and Jones Company, Wilmington, Del., and Ernest Lee Jahncke, president of the Jahncke Dry Dock and Ship Repair Corporation, New Orleans, La., have been named to fill vacancies in the employers' representation on the Atlantic Coast Shipbuilding Industrial Board. The other shipyard representatives are M. A. Neeland, president of the New York Shipbuilding Corporation; John G. Pew, president of the Sun Shipbuilding Company, and Mr. Smith, vice-president of the

Merchant Shipbuilding Corporation. The five labor representatives are James J. O'Connell, president of the Metal Trades Department of the American Federation of Labor; L. L. Letteer, International Association of Machinists; John Tobin, International Brotherhood of Blacksmiths, Drop Forgers and Helpers; Charles F. Scott, International Brotherhood of Boilermakers, Iron Shipbuilders and Helpers, and James A. Cooley, International Union of Steam and Operating Engineers.

GEORGE E. CHAMBERLAIN, former United States senator from Oregon, has been appointed a member of the Shipping Board representing the Pacific Coast States. Mr. Chamberlain was born at Natchez, Miss., in 1854. In 1870 he began work as a clerk in a general merchandise store in Natchez. From 1872 to 1876 he attended the Washington and Lee University and graduated in 1876. In December of that year he went to Oregon, where for a time he taught in a country school. Later he was appointed deputy clerk of his county and in 1879 resigned to practice law. In public life he has served as a member of the Oregon state legislature, as district attorney, attorney general of the state and for two terms beginning in 1903 as governor of Oregon. In 1909 he was elected to the United States Senate and in 1914 reelected.

Hon. G. E. Chamberlain

T. V. O'CONNOR, of Buffalo, N. Y., president of the International Longshoremen's Association, has been appointed to the new Shipping Board as representative of the Great Lakes States. Mr. O'Connor was born in Buffalo 52 years ago. In early life he was a tug worker in Buffalo harbor, later becoming a tug captain. Throughout his life he has been prominent in labor circles, first becoming identified with the Licensed Tugmen's Protective Association which was affiliated with the International Longshoremen's Association. Later he became a member of executive committee, vice-president and later president of that organization, which office he has held for 12 years. In 1921 he was appointed a member of the New York State Industrial Commission. Under the present administration he was offered the post of Assistant Secretary of Labor.

T. V. O'Connor

ELMER SCHLESSINGER, of the law firm of Mayer, Meyer, Austrian and Platt, of Chicago, has been appointed general counsel of the United States Shipping Board. E. M. Hyzer, who has been general counsel, will remain as an assistant to the general counsel. Mr. Schlessinger will receive a salary of $10,000 a year for his services in this post.

J. M. DAVIS, formerly vice-president of the Baltimore & Ohio, has been elected president of Manning, Maxwell & Moore, Inc., 119 West Fortieth street, New York City, to succeed the late A. J. Babcock. Mr. Davis was born on November 5, 1871, and began railway work in 1888. In 1916 he was appointed vice-president in charge of operation and maintenance of the Baltimore & Ohio System, with headquarters at Baltimore, Md., and held that position until July 1, 1918, when, under federal control of the railroads, he was appointed manager of the New York properties of the Baltimore & Ohio, including the Staten Island lines. In 1919 he left the Baltimore & Ohio to become president of the Rock Hill Iron & Coal Company and associated corporations, including the East Broad Top Railroad & Coal Company, with office at New York.

J. M. Davis

ROBERT W. MORRELL, naval architect of the Tidewater Oil Company, New York, has been appointed a member of the new technical committee of the American Steamship Owners' Association, of which William Francis Gibbs, naval architect of the International Mercantile Marine Company, is the chairman.

J. W. ISHERWOOD, of London, Eng., inventor and patentee of the Isherwood longitudinal system of ship construction, has been raised to the rank of Baronet. It is, therefore, as Sir Joseph W. Isherwood, Bart., that he is now being greeted by his many friends in this country where he has just arrived for a visit of several months. Sir Joseph was born at Hartlepool in 1870, and served his apprenticeship in the drawing office of Furness, Withy & Company, Limited, of West Hartlepool, remaining for some years in the service of this firm in various responsible positions. He was associated with Lloyd's Register of Shipping for eleven years, mainly in the capacity of surveyor on the chief ship surveyor's staff, and it was during this period that he became convinced that the then prevailing system of ship construction was not ideal from a scientific standpoint. He therefore set himself the task of evolving a system of construction that would provide increased longitudinal strength, and the result is seen in the longitudinal method of construction known as the Isherwood System which he patented in 1906. He severed his connection with Lloyd's Register in 1907, in order to devote his whole time to the "Isherwood" system, which was first introduced in the United Kingdom, the first vessel so constructed being the oil tank steamer *Paul Paix,* of 6,600 tons deadweight, and so phenomenal has the success of the system been that today there are about 1,400 vessels

Sir J. W. Isherwood, Bart.

aggregating about twelve million tons deadweight carrying capacity, built, building and on order. Sir Joseph is a member of the Institution of Naval Architects, North-East Coast Institution of Engineers and Shipbuilders, the Society of Naval Architects and Marine Engineers (New York), Cleveland Institution of Engineers, and a Liveryman of the Worshipful Company of Shipwrights.

OBITUARY

E. L. ORDE, director of the Walker shipyard of Messrs. Sir W. G. Armstrong Whitworth & Company, Ltd., Newcastle-on-Tyne, Eng., died suddenly in London on May 28, at the age of 57 years. Mr. Orde was educated at Marlborough and the University College, London. He served his apprenticeship with Messrs. R. & W. Hawthorne Leslie & Company, Ltd., St. Peters, Newcastle-on-Tyne, to which firm he was ultimately appointed assistant general manager. Mr. Orde joined Messrs. Sir W. G. Armstrong Whitworth & Company, Ltd., in 1888, as assistant director of the Walker shipyard and on the death of the late Colonel H. F. Swan, was appointed director. Mr. Orde was president of the North East Coast Institution of Engineers and Shipbuilders from 1917 to 1919, and member of the Institution of Naval Architects, of the Institution of Mechanical Engineers, of the Institute of Marine Engineers and of the Engineers and Shipbuilders' Association of Scotland.

NEW BOOKS

SWEET'S ENGINEERING CATALOGUE, Seventh Annual Edition. Compiled, edited and published by Sweet's Catalogue Service, Inc., New York. Cloth, 1251 pages; size, 8½ by 11½ inches; illustrated and indexed.

Sweet's Engineering is a catalogue filing system which contains the separate catalogues of about seven hundred manufacturers. The field it covers is that of engineering and power plant equipment, or, to quote more definitely from the preface, it lists "Materials, equipment and supplies relating to the practical construction, equipment and maintenance of all projects of an industrial or engineering nature." In other words, the products it describes range from drawing boards to dynamos and from lighting receptacles to locomotive cranes.

The seventh edition of Sweet's Engineering Catalogue, which has just appeared, marks an improvement in many ways over those which preceded it. The products index, for example, has been revised and simplified, so that it is now much easier to locate any desired information. This information, in turn, has been arranged in a more logical fashion.

Coen Mechanical Oil Burning System to Be Installed on Government River Towboats

THE United States War Department has recently announced that all the vessels of the new fleet of Government towboats to be operated on the Mississippi and Warrior rivers are to be equipped with the Coen mechanical oil burning system. This system is now in successful operation on the *St. Louis* and *Cairo*, and is now being installed on the *Vicksburg*. The first vessel of this fleet, the *Natchez*, which was described on page 437 of our June issue, was originally equipped with the Leahy steam atomizing oil burning system, but in the near future the oil burners of this vessel will be changed from the steam atomizing to the mechanical type as in the other vessels.

LETTERS TO THE EDITOR

Derivation of Formulae in Paper on Double Reduction Gears for Merchant Ships

The paper on "Double Reduction Gears for Merchant Ships" by R. J. Walker, which was read at the annual meeting of the Institution of Naval Architects and reproduced in the May issue of MARINE ENGINEERING, does not give sufficient data for the application of the formulæ to the actual solution of a problem. In order to determine the units that are represented by the symbols used in this analysis, the writer went through the derivation of the formulæ and found the units.

On page 397 of the May issue the symbol a is used to denote flexibility of the shaft. This factor occurs several times on the sheet. This should be α to correspond with the coordinates of the curve in Fig. 3.

The units and symbols used are as follows:

f = frequency of the resistance moment of the wake.
n = number of blades of the propeller.
R = revolutions per minute of propeller.
p = frequency coefficient.
α = flexibility of shaft.
Is = polar moment of inertia of shaft section.
l = length of shafting in inches from gear to propeller.
G = shearing modulus of elasticity of shaft.
g = the acceleration of gravity.

The relations between the various units are given below:

$$f = \frac{n \times R}{60}$$

$$p = 2 \pi f$$

$$\alpha = \frac{1}{G\ Is}$$

Other units used in the calculations are defined in the paper.

DERIVATION OF FORMULA FOR FLEXIBILITY OF SHAFT

The fundamental formula for angular acceleration of a wheel or disk or propeller rotating about a polar axis is:

$$M = Ia \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where M = torque or moment in inch pounds.
I = moment of mass or polar moment of inertia of propeller.
a = angular acceleration in radians per second.

The fundamental formula for angular deflection of a shaft subjected to a twisting moment is:

$$M = \frac{\theta\ G\ Is}{l} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where M = same as above (torque).
θ = deflection of shaft in radians (twist).
G = coefficient of rigidity (about 12,000,000 for steel).
Is = polar moment of inertia of shaft section.
l = length of shaft in inches.

By algebra we get from (2)

$$\frac{\theta}{M} = \frac{l}{G\ Is} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

From Mr. Walker's paper

$$\alpha = \frac{\text{twist}}{\text{torque}} = \frac{\theta}{M}$$ by using above symbols for twist and torque.

Then from (3) we get $\alpha = \frac{l}{G\ Is}$

Newark, N. J. JAMES L. HAYNES.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements —Engineering Projects—Improved Appliances

$4,800,000 Bond Issue Voted By City of Los Angeles, Cal., To Develop Harbor Facilities

Funds Included for Ferry and Terminals, Wharfage, Equipment and Dredging—$1,000,000 for New Pier—City Sees Bright Future Ahead for West Coast Shipping

Los Angeles, Cal. (Special)—Los Angeles citizens, fully awake to the importance of their harbor development as a distinct and definite profit-earning department of their city organization, voted June 7th with a large majority, an issue of $4,800,000 Harbor Bonds for port improvements.

The main channel from the Los Angeles outer to her inner harbor between the mainland and what is known as Terminal Island, while of ample depth, has long been criticized by shipping men using this port as being too narrow for the volume of business which is there developing. The main channel side of Terminal Island was occupied until recently by trackage of the Salt Lake Railroad. After negotiations extending over some time, the municipal officials arranged a deal with the Salt Lake Railroad by the terms of which the tracks of that road had been removed from the channel edge and a slice of Terminal Island along the channel bank, sufficient to give a minimum width of 1,000 feet to the main channel, is being cut off, dredged and the new water line of Terminal Island along the channel front, through the use of a portion of the issue of the bonds just voted, is to be made into the most modern type of wharfage with warehouses and cargo handling facilities.

Among other improvements to be immediately carried out with the bonds now rendered available, is the improvement of the West Basin. Around the shores of the West Basin is a very large acreage of partially "made" land. It is on seventy acres of this land completely reclaimed and with deep water all around it, that the plant and dry dock of the Los Angeles Shipbuilding & Dry Dock Company is located. The balance of the land as laid out in the plans of the city engineers, when reclamation work is complete and wharves built along its water edge, will provide accommodations for many large industrial plants needing rail and water shipping facilities. Of the bond issue just voted, $400,000 is to be set aside for this work.

Certain of the dredging operations in the formation of Inner Harbor channels and tide land reclamation is being done by the dredges of the Government; the exact amount of wharfage, cargo handling improvements, etc., which the city of Los Angeles will be able to accomplish with its $4,800,000 will be somewhat governed therefore by the degree of co-operation given by the Government in dredging operations.

The center of the city of Los Angeles is a little over twenty miles from the nearest waterfront at the harbor. From that waterfront point and on each side of it for several miles sweeping back towards the city are some thousands of acres of flat, easily dredged land—the most ideal of all for channels, wharves and industrial harbor front development progress. This great "apron" at the edge of the water supported by a modern city of over 600,000 population and fast growing, a few miles back is, in the opinion of its experts, one of the greatest of harbor assets. It is here that the modern harbor engineer can lay out the most suitable of industrial sites with water and rail transportation facilities, placing these where industry needs them.

The natural advantages of the outer harbor of Los Angeles with its broad sweep to the open sea and its ample protection for naval and merchant marine vessels inside its breakwater, have been noted by all who know the Pacific coast. Now that the city is developing a realization of what a great port will mean to it and is beginning to provide the means to build the docks, wharves, warehouses and cargo handling facilities demanded by shipping men, real and very rapid progress may be counted upon. Following is a list of the improvements planned to be carried out with the proceeds from the sale of the $4,800,000 of Harbor Bonds just authorized:

Municipal pier No. 1	$1,000,000
West Basin development	400,000
Fish Harbor improvements	500,000
Belt line railroad	300,000
Harbor boulevard	600,000
New sheds, etc., on east side of main channel	500,000
Ferry and terminals	200,000
Terminal Island seawalls	200,000
Wharves on west side of main channel	800,000
Equipment	300,000
Total	$4,800,000

$413,067,039 Agreed Upon by Senate and House for Navy Bill

The Naval appropriation bill carrying $413,067,039 has been agreed upon by the House and Senate conferees. This figure is an increase of $17,615,790 over the House bill.

The personnel of the Navy was fixed at 106,000 and the marine corps at 21,000.

Six Refrigerator Ships to Cost $1,500,000 Are Planned by Producers' Association

Investment of approximately $1,500,000 for the equipment of six ships with refrigerated space for the carrying of cargoes of fruit from the ports of Los Angeles and Seattle to Atlantic Coast points is contemplated in the plans of the Pacific Producers' Association, according to a statement by C. S. Whitcomb, its president. The carrying out of the plans will make possible a ten day service between the ports of Los Angeles and Seattle, each ship having 200,000 cubic feet of refrigerated space. It is considered likely that one or more ships will be equipped in three months and the full service of six ships established within six months.

World Machinery Market

A mammoth, comprehensive world market for machinery has been established in the building occupying the block of Sixth avenue, 18th and 19th streets, New York. It is a new style of world market, broad in scope thoughtfully planned and intended for American and international promotion of the sale of all American-manufactured mechanical products. It comprises exhibits of machinery of all kinds, and as New York is considered the biggest machinery center in the world, this new world market is looked upon as being of great advantage to manufacturers, selling agents and buyers. The Manufacturers' Exhibition Company, now permanently established, has located this concentrated market in the busy center, accessible to all surface, elevated and subway lines.

The machinery department contains all machine tools and iron-working machinery, pumps, valves and piping, lathes, planers, drilling machinery, horizontal and vertical boring machines, grinding machinery, automatic screw machines, drawing and punching boards, welding devices, heat treating equipment, and general machine tools, and various other mechanisms.

New Construction Included in Coast, Bay and Port Developments

Numerous marine projects covering river and bay service, as well as port developments, are already under way or in contemplation, according to latest official reports.

The development of water transportation in the Chesapeake Bay and tributaries is being augmented through the establishment of service from Richmond to Norfolk by the Buxton Line and the rebuilding of several vessels for their account through Chapman & Fisher, Philadelphia, consulting engineers and naval architects.

Also, a program under way for coast and bay service calls for the construction of two small passenger and freight vessels for additional lines to be inaugurated early in 1922. Plans and specifications are being proceeded with by Chapman & Fisher and the vessels are to be constructed at their shipyard on the Great Lakes.

The vessels of the Diamond Steamship Company have been sold by the same engineering firm, and the company which was originally organized to develop service between North Atlantic ports and Ecuador, South America, will confine its attention to its machinery interests.

It is learned through official advices from John N. Cole, commissioner, Department of Public Works, Boston, that the Commonwealth of Massachusetts has let a contract for dredging and filling 1,000,000 cubic yards of material at East Boston, and the construction of about one-half mile of timber bulkhead, to retain a filling, to the Atlantic, Gulf & Pacific Company, Park Row Building, New York. The amount of the bid for this work, which is on the easterly side of East Boston, between Jeffries Point and Wood Island, is $351,400. It is also learned that the legislature has recently revised the harbor lines on the westerly side of East Boston in order to give better opportunity for the development of this area of flats.

Additions and extensions of the harbor facilities of Philadelphia are being actively promoted by the Department of Wharves, Docks and Ferries, of that city. It is now directly supervising the construction of six piers, and is strongly interested in promoting the port's interests in other directions.

Marine Representatives Inspect the Electric Drive Ship "Eclipse"

Naval architects, consulting and superintending engineers of several steamship companies and representatives of various marine publications were guests of the General Electric Company on an inspection of the S. S. *Eclipse*, Tuesday afternoon, May 24.

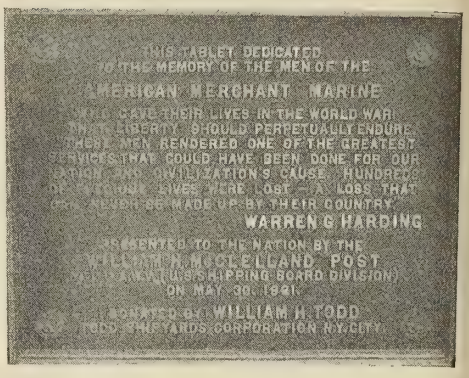
Many inquiries have been received by the United States Shipping Board since the return of this first electrically propelled freighter, with a clean record for a trip of 26,500 miles, and it was in response to these that Commander V. V. Woodward suggested the inspection. The trip was under the direction of H. B. Taylor, chief turbine engineer of the Shipping Board.

The party, numbering about 35, made the trip to the ship, docked at Staten Island, in the Tebo yacht *Natalie Mae*. After inspecting the equipment and having it explained by General Electric engineers, the return was made to the Battery.

In the evening the engineers of the *Eclipse* were entertained at dinner by the General Electric Company at Corsican's, Brooklyn, in compliment to their services which tended to make this initial voyage the complete success it proved to be. Among the guests were H. B. Taylor; his assistant, George M. Walker, and P. J. Henning, electrical inspector of the Shipping Board.

Visiting Party on the Eclipse

TABLET PRESENTED


THIS TABLET DEDICATED
TO THE MEMORY OF THE MEN OF THE
AMERICAN MERCHANT MARINE
WHO GAVE THEIR LIVES IN THE WORLD WAR
THAT LIBERTY SHOULD PERPETUALLY ENDURE
THESE MEN RENDERED ONE OF THE GREATEST
SERVICES THAT COULD HAVE BEEN DONE FOR OUR
NATION AND CIVILIZATION'S CAUSE HUNDREDS
OF THEIR LIVES WERE LOST A LOSS THAT
CANNOT BE MADE UP BY THEIR COUNTRY
WARREN G HARDING
PRESENTED TO THE NATION BY THE
WILLIAM H. McCLELLAND POST
AMERICAN LEGION SHIPPING BOARD DIVISION
ON MAY 30, 1921
DONATED BY WILLIAM H. TODD
TODD SHIPYARDS CORPORATION N.Y.CITY

Appropriate ceremonies marked the unveiling at the Custom House, New York City, at 10 a. m., Memorial Day, of a bronze tablet dedicated to the memory of the men of the American Merchant Marine who lost their lives during the war. The tablet, which has been donated by William H. Todd, president of the Todd Shipyards Corporation, was presented to the nation by the William H. McClelland Post, U. S. Shipping Board Division.

INVINCIBLE'S TRIP

Electric Drive Ship Makes Foreign Voyage With Fine Results

The S. S. *Invincible*, of the Cosmopolitan lines, second of the electrically propelled cargo carriers, docked at Bayonne recently, having completed her first ocean voyage with new equipment, a trip to Rotterdam and return—7,300 miles—with highly successful results.

The *Invincible* left New York May 1 with a light cargo. Heavy seas were encountered, resulting in the propeller leaving the water on many occasions but there was no racing of the propeller. Her speed did not vary more than one revolution per minute, convincing proof of one of the important advantages of the electric drive. She started on her return from Rotterdam on May 21 with a cargo of 2,500 tons and again experienced rough seas but with the same results.

Her average speed for the trip 10.86 knots, which resulted in her making the voyage in more than one day's less time than similar boats not equipped with the electric drive. Officers on board were high in praise for the equipment, in fact Captain John Rehnberg, senior skipper of the Cosmopolitan lines and a man with 43 years sea experience, declared the electric drive the best means of ship propulsoin he has yet had anything to do with.

"You can't praise the electric drive too highly in expressing my first experience as commander of a vessel with the new type of propulsion," declared Captain Rehnberg. "It is absolutely the best means of propulsion I have encountered in my 43 years experience at sea."

The *Invincible* was built by the Bethlehem Shipbuilding Corporation at the Union plant, San Francisco, in 1918. She is the second of twelve 12,000 ton vessels being equipped by the General Electric Company with the electric drive for the United States Shipping Board.

RECORD ESTABLISHED

West Coast Concern Does Exceptional Work on Destroyer

Lieutenant M. B. Pollock, naval constructor assigned to duty in the plant of the Los Angeles Shipbuilding & Dry Dock Company to supervise dry docking and repairs of United States destroyers and Pacific Fleet auxiliaries at that plant, is credited with the development of a particularly ef-

ficient system of handling each destroyer, with the result that through the cooperation of officials and personnel of the plant and of the commander, officers and crew of the ships to be docked, he has created a record of raising a destroyer, thoroughly cleaning the hull, painting it with two coats, cutting in the new waterline and undocking the ship, sending her on her way back to her base within the remarkably short space of five hours.

The destroyer *Farquhar,* commanded by Lieutenant R. G. Coman, entered the dry dock of the Los Angeles concern June 4, was officially raised at 10:35 A. M., and exactly at 3:33 P. M. the *Farquhar* was again afloat with the company's tug *Bedford* towing her clear of the dock and heading her seaward. These dry docking facilities permit of a destroyer leaving San Diego in the early morning, being raised, cleaned and painted with two coats, and returning, to be moored at her base again the same evening.

Baltimore Marine Show

The Baltimore Marine Show and Export and Import Exposition will be held in the 5th Regiment Armory, Baltimore, July 11-16, conducted by the Export and Import Board of Trade of that city. The show will be under the patronage of the Mayor of the city and civic officials, the Merchants & Manufacturers Association, the Board of Trade of Baltimore, the Baltimore Chamber of Commerce, and will be held under the auspices of the National Marine League.

Immigration Figures Show Aliens Arriving Since June 3 and the Number Permissible

Arrivals At American Ports Since Application of Restriction Law Already Exceed in Many Cases the Quota Allowed For the Entire Month

The arrival of immigrants who have come into American ports since the application of the restriction law of June 3, already exceeds, in the case of many nationalities, the quota allowed for these nationalities for the entire month, according to statements from Washington. Steamship men state that this condition is due entirely to the short time they were given in which to put the provisions of the law into effect and to what they term "unworkable methods" for carrying out the provisions of the law.

According to official figures, the United Kingdom, with 15,441, has the greatest limit per month for the fiscal year, 1921-1922.

The United States Department of Labor of the Bureau of Immigration has issued the following table, giving the number of aliens admissible under the act of May 19, 1921:

Country or Place of Birth.	Quota June 3-30 1921.	Quota Fiscal Year 1921-22.	Limit Per Month Fiscal Year 1921-22.
Albania	22	287	57
Austria	571	7,444	1,489
Belgium	119	1,557	311
Bulgaria	23	301	60
Czechoslovakia	1,095	14,269	2,854
Danzig	22	285	57
Denmark	433	5,644	1,129
Finland	298	3,890	778
Fiume	5	71	14
France	437	5,692	1,138
Germany	5,219	68,039	13,608
Greece	252	3,286	657
Hungary	432	5,635	1,127
Italy	3,224	42,021	8,404
Jugoslavia	491	6,405	1,281
Luxemburg	7	92	18
Netherlands	276	3,602	720
Norway	930	12,116	2,423
Poland	1,528	20,019	4,004
Eastern Galicia	451	5,781	1,156
Portugal (including Azores & Mad. Isl.)	177	2,269	454
Roumania	569	7,414	1,483
Russia (including Siberia)	2,627	34,247	6,849
Spain	51	663	133
Sweden	1,531	19,956	3,991
Switzerland	287	3,745	749
United Kingdom	5,923	77,206	15,441
Other Europe (including Andorra, Gibraltar, Malta, Lichtenstein, Monaco, San Marino and Iceland)	6	86	17
Armenia	122	1,588	318
Palestine	4	56	11
Smyrna District	34	438	88
Syria	69	905	181
Other Turkey (Europe and Asia)	16	215	43
Other Asia (including Persia and territory other than Siberia, which is not included in the Asiatic Barred Zone. Persons born in Siberia are included in the Russian quota.)	6	78	16
Africa	9	120	24
Australia	21	271	54
New Zealand	4	50	10
Atlantic Islands (other than Azores, Madeira and islands adjacent to the American continents)	5	60	12
Pacific Islands (other than New Zealand and islands adjacent to the American continents)	2	22	4
Total	27,298	355,825	71,163

Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Repair Schooner, Boothbay, Maine.—The schooner Jennie Flood Kreger, which was in collision off Cape Henry recently, is being repaired at a cost of $40,000.

To Rebuild Vessel, Seaford, Del.—The schooner Arthur W. Robinson, purchased in a disabled condition at Miami by Captain John Quillen of Laurel, Del., will be rebuilt at the Vane Shipyard.

Hawkeye State Contract, Newport News, Va.—The contract for the alteration of the United States Shipping Board steamer Hawkeye State has been awarded to the Newport News Shipbuilding & Dry Dock Company on a bid of $97,550. The vessel is one of the 535-foot type.

Contract Awarded Shooters Island, New York.—The Standard Shipbuilding Company has been awarded the contract for repairs to the steamer Lord Ormonde, the company being the low bidder on the opening of tenders June 3.

Dump Scows, Wilmington, Del.—The American Car & Foundry Company has been awarded the contract for the construction of three wooden dump scows by the United States Engineer Department of New York.

Repair Contracts, Baltimore, Md.—The Globe Shipbuilding Company was awarded the contract for the repairs to the steamer Antinous, being the lowest bidder at $4,840.

Repair Contract Award, Baltimore, Md.—The Shipping Board has awarded a contract for docking and repairs to the steamer Sahala to the Baltimore Dry Docks & Shipbuilding Company, at a bid of $5,454. This company was the lowest bidder for repairs to the steamer Chickasaw at $570, and making changes on the submarine chaser allocated by the United States Navy to the Baltimore Fire Department, at a bid of $875. Contracts for repairs to the British steamers Pinar Del Rio at $1,409 and the Santa Clara for $1,399 were awarded to the Globe Shipbuilding Company, of Baltimore.

Shipyard Activities at San Francisco, Cal.—According to Gordon Glidden of the Moore Shipyards his company is now working on seven vessels. The boilers of the British tanker Tachee of the Standard Oil Company are being retubed and the craft is also undergoing a general overhauling at the yard. The tanker S. C. T. Dodd of the same company is being repaired, while five vessels are outfitting.

Ship Repair Bids, Hoboken, N. J.—The W. & A. Fletcher Company was low bidder for repairs to the Shipping Board steamer Old North State, tenders for which were opened at 45 Broadway, New York, on June 3. The price was $7,320. With a figure of $2,523, the Standard Shipbuilding Corporation, Shooters Island, were low bidders for the Shipping Board steamer Kamiset for repairs. The same company also bid low for the steamer Lord Ormonde, which was handled by McFarland & Garney, 32 Broadway. The price was given as about $24,000.

Reconditioning Contract, Hoboken, N. J.—The W. & A. Fletcher Company has been awarded the contract for reconditioning the Polish Relief ship Gdanst, which is being handled by Esplen Sons & McNaught, of 18 Broadway, New York. The work will include the renewal of the smokestack and uptakes, extensive bottom repairs, renewal of the tail shaft and various voyage repairs. It is understood that the contract will involve about $25,000.

Pilot Boat, New York.—The new boat for the Baltimore Pilots' Association will be completed on October 1 by Kyle & Purdy, Inc., New York, who have been awarded the contract. It was stated that the association has purchased the steel hull which was originally laid down by the Kyle & Purdy company for the French Government, and a compound engine, 18 by 38 by 26 inches stroke, will be installed. The vessel will also be equipped with one Scotch boiler, 13 feet 6 inches in diameter by 12 feet in length to carry 180 pounds of steam, working pressure. The boat is 150 feet long by 15 feet beam, having a depth of 14 feet 7 inches. The firm of Cox & Stevens, of New York, are the naval architects.

Refrigerator Ships, New York.—H. D. Donald, of 11 Broadway, New York, is acting as the representative of American interests who have under consideration the building of two refrigerator ships, according to official information obtained by MARINE ENGINEERING. It is understood that the proposed vessels are to be of from 2,000 to 2,500 deadweight tons, draft not to exceed 12 or 13 feet. It was announced that the vessels are to be equipped with triple expansion engines with oil burning equipment and are to have a speed of not less than 12 knots. If it is decided to build these ships, it was stated that they would be for delivery early next year.

Reconditioning Tanker, Hoboken, N. J.—The tank ship Pioneer, of the Standard Oil Company of New Jersey, was repaired by the W. & A. Fletcher Company, the latter concern having been awarded the contract, which included the reconditioning of the ship's fuel oil tanks, some new construction work, machinery repairs, together with repairing extensive bottom damage. It is believed the total contract involved over $20,000.

May Build Six and Purchase Two Vessels, New York—The Department of Street Cleaning submitted to the Board of Aldermen on June 7 a request that the Board authorize the purchase without public letting, of two (2) vessels known as "Eastman Dumpers," at a cost not to exceed $50,000, and of licenses to build six (6) vessels of a similar type under the patent rights held by F. P. Eastman at a sum not to exceed $75,000. Funds are available for these purposes out of appropriations made by the Board of Estimate and Apportionment on June 25, 1920, amounting to $625,000, and on March 19, 1921, amounting to $150,000, for the construction of five (5) sea dumpers and two (2) unloading plants. The purpose of these purchases is to add to the present fleet of vessels used for disposing of garbage at sea. The matter was referred to the Committee on Public Letting.

Torpedo Boats, Bridgeport, Conn.—The Lake Torpedo Boat Company may yet be awarded the contract for at least a number of the six submarine torpedo boats provided for in Senator McLean's amendment to the Naval Appropriation Bill, which authorizes the Navy Department to go ahead with the building of the six submarines specified in the 1916 naval program, according to latest reports from Connecticut. This optimistic view was given out following the return to Bridgeport of James F. Hennessey, who went to Washington in behalf of the employees of the Lake Company. It is understood that the six submarines will cost approximately $5,000,000 each, and that awarding of the contract to the Lake Company will mean employment for over 2,000 men.

Tanker, Wilmington, Del.—Announcement is made of the placing of a contract for the construction of a 2,500-ton tanker by the Atlantic Refining Company, of Philadelphia, with the Bethlehem Shipbuilding Corporation. The ship is to be 266 feet in length, 39 feet beam, and 20 feet deep. Construction will be on the Isherwood system of longitudinal framing, the work to be done at the shipbuilding company's Harlan plant.

Bids for Steamer Repairs, Halifax, N. S.—Bids for repairing the steamship Impoco which was rescued from Blonde Rock, off the Canadian Coast, and which was looked upon as one of the biggest repair contracts so far this year were opened at Halifax—the tenders showing prices ranging from $232,000 to $390,000. The Halifax Shipyards, Ltd., was low bidder at the figure of $232,000. Frazier-Brace & Company, of Montreal, was next with a figure of $260,000. The figures submitted by American shipbuilders and drydock companies ranged from $274,000 to $390,000, the firms from the states being handicapped to the extent of $39,500, which amount includes temporary repairs to make the vessel seaworthy for the trip to New York and tonnage charges in addition to the Canadian tax of 25 percent on repairs accomplished in the United States, together with the difference in exchange rate. It was agreed in order to offset this handicap that the time of commencement would begin when the vessel reached the successful bidder's yard and that no liquidated damages be assessed for failure to complete the work on time. The American bidders were the W. & A. Fletcher Company, Robins Dry Dock & Repair Company, New York Harbor Dry Dock Company, Staten Island Shipbuilding Company, Morse Dry Dock & Repair Company, the Baltimore Dry Docks & Shipbuilding Company. It was reported that the ship had been declared a total loss. If this should transpire, shipbuilders are interested in whether or not the vessel will be replaced. The bottom of the Impoco was virtually demolished and the repairs would necessitate extensive work on the propelling machinery and other equipment.

May Buy Ferryboats, New York—Purchase of the ferryboats, Florida, Joseph H. O'Donohue and Wyoming by the Department of Plant and Structures and their reconditioning for service under the jurisdiction of that department is expected soon, providing satisfactory terms can be agreed upon, according to announcement from Commissioner Grover A. Whalen. These boats will probably be started in service from East 23rd street to Greenpoint, Brooklyn, N. Y. Although the sum of $742,000 had been asked by Commissioner Whalen for the rebuilding of the ferry terminals at the foot of Broadway, Brooklyn, and at the foot of Grand street, Manhattan, and for the purchase or construction of ferryboats, it was stated that $696,000 of the original figure will be available.

Considering Ferry, Los Angeles, Cal.—It was learned from Mayor Snyder of Los Angeles through Edwin D. Vincent, harbor engineer, that the city is contemplating building a ferryboat to serve between San Pedro and East San Pedro. No plans have as yet been made and it may be some time before the matter will be actively taken up inasmuch as the channel is to be widened to 1,000 feet before this improvement can be undertaken. The city is at present completing the construction of a 200 horsepower tugboat for service in towing rock barges from the city quarry to Catalina Island to this port, also a 35-ton floating derrick barge for general use in the harbor.

Contracts Awarded, Hoboken, N. J.—The contract for voyage repairs and overhauling the lubricating oil system and the institution of new tanks in the ship Veedol of the Tidewater Oil Company has been awarded to the W. & A. Fletcher Company, to cost about $7,000. The same company has also been awarded the Shipping Board steamer West Point for general reconditioning at a similar figure.

CONSTRUCTION FOR NAVY

Vessels under construction for the United States Navy and their degree of completion as reported May 31, 1921, by the Bureau of Construction and Repair, Washington, D. C., are as follows:

Type Number and Name	Contractor	Per Cent. of Completion May 1 Total
BATTLESHIPS (BB)		
44 California	Mare Island Navy Yard	97.
45 Colorado	New York S. B. Corpn.	73.1
46 Maryland	Newport News S. B. & D. D. Co.	99.2
47 Washington	New York S. B. Corpn.	65.
48 West Virginia	Newport News S. B. & D. D. Co.	54.1
49 South Dakota	New York Navy Yard	30.5
50 Indiana	New York Navy Yard	28.
51 Montana	Mare Island Navy Yard	24.4
52 North Carolina	Norfolk Navy Yard	32.3
53 Iowa	Newport News S. B. & D. D. Co.	23.
54 Massachusetts	Beth. S. B. Corpn. (Fore River)	6.4
BATTLE CRUISERS (CC)		
1 Lexington	Beth. S. B. Corpn. (Fore River)	18.7
2 Constellation	Newport News S. B. & D. D. Co.	10.5
3 Saratoga	New York S. B. Corpn.	22.4
4 Ranger	Newport News S. B. & D. D. Co.	1.8
5 Constitution	Philadelphia Navy Yard	7.7
6 United States	Philadelphia Navy Yard	7.7
SCOUT CRUISERS (LIGHT CRUISERS CL)		
4 Omaha	Todd D. D. & Const. Corpn.	92.1
5 Milwaukee	Todd D. D. & Const. Corpn.	89.2
*6 Cincinnati	Todd D. D. & Const. Corpn.	81.7
7 Raleigh	Beth S. B. Corpn. (Fore River)	56.7
8 Detroit	Beth S. B. Corpn. (Fore River)	56.6
9 Richmond	Wm. Cramp & Sons Co.	66.
10 Concord	Wm. Cramp & Sons Co.	63.
11 Trenton	Wm. Cramp & Sons Co.	45.
12 Marblehead	Wm. Cramp & Sons Co.	43.
13 Memphis	Wm. Cramp & Sons Co.	37.

*Scout cruiser (light cruiser) No. 6—Launched 5-23-21.

AUXILIARIES

Fuel Ship No. 18, Pecos (Oiler AO6)	Boston Navy Yard	88.
Repair Ship No. 1, Medusa (AR1)	Puget Sound Navy Yard	62.4
*Dest. Tender No. 3, Dobbin (AD3)	Philadelphia Navy Yord	62.3
Dest. Tender No. 4, Whitney (AD4)	Boston Navy Yard	25.
Sub. Tender No. 3, Holland (AS3)	Puget Sound Navy Yard	17.8
Aircraft Tender, Wright (AZ1)	Tietjen & Lang	76.

*Destroyer Tender No. 3—Launched 5-5-21.

PATROL VESSELS

Gunboat No. 22, Tulsa (PG22)	Charleston Navy Yard	67.7

Authorized but not under construction or contract.
(1) Transport No. 2.

DESTROYERS

332 Farenholt	Beth. S. B. Corpn. (San Fran.)	Del.
333 Sumner	Beth. S. B. Corpn. (San Fran.)	Del.
334 Corry	Beth. S. B. Corpn. (San Fran.)	Del.
335 Melvin	Beth. S. B. Corpn. (San Fran.)	Del.
338 Wasmuth	Mare Island Navy Yard	97.7
339 Trever	Mare Island Navy Yard	94.8
340 Perry	Mare Island Navy Yard	61.4
341 Decatur	Mare Island Navy Yard	57 6

Destroyers authorized but not under construction or contract.
(12) Nos. 348 to 359 inclusive.

SUBMARINES

115 S-10	Portsmouth, N. H., Navy Yard	90.8
116 S-11	Portsmouth, N. H., Navy Yard	86.8
117 S-12	Portsmouth, N. H., Navy Yard	78.1
118 S-13	Portsmouth, N. H., Navy Yard	75.
123 S-18	Electric Boat Co. (Quincy)	97.
124 S-19	Electric Boat Co. (Quincy)	96.5
125 S-20	Electric Boat Co. (Quincy)	98.5
126 S-21	Electric Boat Co. (Quincy)	94.9
127 S-22	Electric Boat Co. (Quincy)	95.8
128 S-23	Electric Boat Co. (Quincy)	94.
129 S-24	Electric Boat Co. (Quincy)	93.
130 S-25	Electric Boat Co. (Quincy)	93.5
131 S-26	Electric Boat Co. (Quincy)	92.4
132 S-27	Electric Boat Co. (Quincy)	91.
133 S-28	Electric Boat Co. (Quincy)	91.6
134 S-29	Electric Boat Co. (Quincy)	90.5
136 S-31	Electric Boat Co. (San Fran.)	97.5
137 S-32	Electric Boat Co. (San Fran.)	95.6
138 S-33	Electric Boat Co. (San Fran.)	99.2
139 S-34	Electric Boat Co. (San Fran.)	94.8
140 S-35	Electric Boat Co. (San Fran.)	90.7
141 S-36	Electric Boat Co. (San Fran.)	86.6
142 S-37	Electric Boat Co. (San Fran.)	82.8
143 S-38	Electric Boat Co. (San Fran.)	72.6
144 S-39	Electric Boat Co. (San Fran.)	71.6
145 S-40	Electric Boat Co. (San Fran.)	71.9
146 S-41	Electric Boat Co. (San Fran.)	73.6
153 S-42	Electric Boat Co. (Quincy)	64.6
154 S-43	Electric Boat Co. (Quincy)	64.8
155 S-44	Electric Boat Co. (Quincy)	63.1
156 S-45	Electric Boat Co. (Quincy)	63.9
157 S-46	Electric Boat Co. (Quincy)	62.2
158 S-47	Electric Boat Co. (Quincy)	61.8
159 S-48	Lake T. B. Co. (Bridgeport)	91.4
160 S-49	Lake T. B. Co. (Bridgeport)	85.2
161 S-50	Lake T. B. Co. (Bridgeport)	81.7
162 S-51	Lake T. B. Co. (Bridgeport)	71.2

FLEET SUBMARINES

60 T-2 (SF 2)	Electric Boat Co. (Quincy)	98.7
163 V-1 (SF 4)	Portsmouth, N. H., Navy Yard	2.8
164 V-2 (SF 5)	Portsmouth, N. H., Navy Yard	2.8
165 V-3 (SF 6)	Portsmouth, N. H., Navy Yard	2.8

Fleet Submarines (6) Nos. 166 to 171.
Neff Submarine (1) No. 108.
Note: Submarines authorized but not under construction or contract.

Repairing Steamers, Baltimore, Md.—The Baltimore Dry Docks & Shipbuilding Company was the lowest bidder at a figure of $1,712, on the contract for the removal and installation of a new turbine engine in the Shipping Board steamer West Raritan. The H. E. Crook Company, also of Baltimore, was awarded the contract for repairs to the Lake Ellerslie at a bid of $532. A contract to repair the lighthouse tender Orchid has been awarded by the Bureau of Lighthouses to the Spedden Shipbuilding Company, of Baltimore, Md.

New Passenger Vessel, San Francisco, Cal.—Lebeus Curtis, of the firm of Pillsbury & Curtis, marine surveyors, has arrived at San Francisco from Honolulu where he had been for the past month studying shipping conditions and advising with the managers of the Interisland Steam Navigation Company in regard to a new steamer they contemplate building. Plans for going ahead with the vessel are being held in abeyance, but it is understood that when she is built the contract will go to a San Francisco shipyard. The vessel is to be a little larger and a little faster than any the company now has plying between the various islands, the largest of which is about 1,600 gross tons. She will have accommodations for 200 passengers and will make about 16 knots.

Derrick Boats—The United States District Engineers Department, Custom House, Nashville, Tenn., let a contract for the construction of two derrick boats to the Howard Ship and Dock Yards, Division and Market streets, Jeffersonville, Ind., at a price of $11,490 each.

To Install Engines—Consideration is being given a plan to install engines in several former German barks now lying off Sausalito, fostered by W. L. Comyn, and to this end draftsmen of the Union Iron Works, San Francisco, Cal., have submitted specifications for installing 500-horsepower engines in the bark Hans. In the event of a decision to carry out the project, engines now in motorships of the Pacific Freighters Company will be used, according to Mr. Comyn. These engines have a speed of 10 knots and are capable of generating 600 horsepower.

Ship in Collision—The Shipping Board steamer Charlot, which recently encountered an iceberg, is now in the harbor of St. Johns, N. F., with her entire forepart wrecked, her first bulkhead being shattered. Repairs will require three months' work, it is estimated.

Tugboats Building—The Transportation & Shipping Company, Ltd., Sorel, Can., are busy completing two ocean-going steel tugs, 133 feet long and of 600 horsepower. Two wooden tow barges of 1,800 tons each are also being constructed by the same company for their own account.

SHIPYARDS AND DRY DOCKS

Dry Dock, Baltimore, Md.—The Union Shipbuilding Company has engaged the Crandall Engineering Company, Boston, Mass., to install a standard Crandall railway dry dock of 4,000 tons lifting capacity. This new dock will measure 360 feet over the keel blocks, 70 feet wide, with 15 feet of water forward and 20 feet aft over the blocks, and will be capable of docking vessels up to and including the 8,800-ton class of ships. A large quantity of material is now on the ground and the construction will be started as soon as dredging is completed.

Dry Dock, Sydney, N. S.—The railway drydock being built for the Sydney Foundry and Machine Works, Ltd., is designed and is being constructed by the Crandall Engineering Company of Boston, Mass. Vessels displacing up to 1,200 tons will be accommodated on this new dock, which measures 200 feet over the keel blocks, 50 feet wide and gives 10 feet of water forward and 16 feet aft over the blocks. The construction will be complete and the dock in operation in about two months.

Drydock, Etc., Miami, Fla.—The Merrill Stevens Drydock & Repair Company, Jacksonville, Fla., is reported to be contemplating the establishment of a marine repair plant at Miami, Fla.

To Sell Shipyard, New Orleans, La.—The French High Commission, New York, is offering for sale the Foundation Company's yard at New Orleans, where the 6,000 ton La Parmentier type ships were built. The yard covers an area of 90 acres with a launching basin of 20 acres. The yard has three launching ways.

Drydock, New Brunswick, Can.—The St. John Dry Dock & Shipbuilding Company will build and operate a first class drydock for naval and general purposes. The drydock will be capable of taking ships over 600 feet long and will embody in its construction the last and most efficient features, and be equipped with a traveling crane capable of lifting 40 tons at a reach of half the width of the dock, which is to be 1,150 feet in length. Preparations are being made to proceed with the concrete construction of the dock this summer. A. R. Dufresne is engineer and manager.

PORT IMPROVEMENTS

Pier Equipment, New York City—Resolutions recommending to the Board of Estimate and Apportionment that the comptroller be authorized to issue corporate stock to the amount of not exceeding $430,000, the proceeds whereof to be used for equipment of piers now in the course of construction at Staten Island, were unanimously adopted at the recent meeting of the Commissioners of the Sinking Fund. The equipment includes seventy-two 2-ton cargo winches with wiring at $3,000 each, a number of capstans, cargo chutes, cargo booms, and railroad tracks and crossovers.

Cranes for South America—The Industrial Equipment Company, 149 Broadway, New York, is reported to be receiving bids on a South American inquiry calling for forty 1-ton 10 to 12 foot boom, gasoline operated, solid rubber tired truck cranes for operation on docks.

Piers, Equipment, Etc., Norfolk, Va.—The Port Commission has plans and final estimates of proposed harbor improvements including grain elevator, additional piers and warehouses, and equipment. Neff & Thompson, Seaboard Bank Building, Norfolk, and Folwell, Ahlstog & Company, McCormick Building, Chicago, Ill., are the architects.

Million Dollar Pier, Venice, Cal.—The Sunset Pier Company, Trollyway, let a contract for the construction of an amusement pier 700 feet into the ocean, 607 feet frontage, and 100 feet wide, to be horseshoe shaped, of concrete or willite surfaced deck on wood piles, to Murdock & Condel, 1715 West 24th street, Los Angeles, Cal. The entire project will cost about $1,000,000.

Dredging, Minnesota—C. E. Boughton, attorney for the State Drainage Board at Red Lake Falls, Minn., will receive bids until July 15 for dredging and straightening the Clearwater River, involving the expenditure of about $100,000. G. Walker, Thief River Falls, is engineer.

Wharf, Valparaiso, Fla.—John P. Perrine, mayor, has let contract for the construction of a 48 by 72 foot wharf and loading docks, etc., to the Holbrook, Rowland Construction Company, at a cost of $6,000. N. C. Rowland is engineer.

Dredging, Goderich, Ont.—The Department of Public Works, Parliament Building, Ottawa, Can., is receiving bids for dredging the harbor, involving 50,000 cubic yards floating dredgework, at an estimated cost of $30,000. E. LaFleur, Parliament Building, is engineer.

Breakwater, Twillingate, Can.—The sum of $25,000 has been secured for the construction of a breakwater at Twillingate, New Foundland harbor, and work is to be started soon. The Government has sent engineers to look over the site and to report whether it is the best possible in the interes of the people of Twillingate.

May Build Piers, New York—Matters which were referred to the Committee of the Whole by the Sinking Fund Commission of the City of New York, at its meeting on May 28, 1921, include requests from the Commissioner of Docks for adoption of a resolution recommending to the Board of Estimate and Apportionment that the comptroller be authorized to issue corporate stock in the sum of $540,000 to cover the cost of removing the present pier at the foot of West 44th street, Manhattan, and constructing a new pier in its place; also an issue in

the amount of $100,000 for the construction of a bulkhead wall and for removing portions of the piers, sheds and cribs on the inshore ends of piers (old) 1 and 2, North River.

Dock, Hollister, Mo.—The city will construct a dock at the mouth of Turkey Creek at Lake Taney. Address the mayor.

Terminal, Demopolis, Ala.—The city contemplates the construction of a river terminal to cost $50,000.

Ferry, Valparaiso, Fla.—John B. Perrine, mayor, invites bids on the construction of a ferry across Valparaiso Bay.

Wharf, Etc., Valparaiso, Fla.—Bids will be received by John B. Perrine, mayor, for the construction of a wharf and warehouse on Sunset Bay.

Terminals, Helena, Ark.—The city plans the construction of wharf, boat and railway facilities along the waterfront. Address the mayor.

Pier, New Bedford, Mass.—W. S. Rendle, 135 Prescott street, East Boston, Mass., has been awarded a contract for the construction of a pier at the New Bedford and Fairhaven drawbridge, at a cost of $48,413.

Wharf, Marion, Mass.—The town plans to build a concrete wharf on Sippican Harbor to cost about $25,000. The engineer has not as yet been selected.

Dock, Bulkhead, Palmetto, Fla.—W. E. Mann, clerk for the city, has let a contract to George Skene for the construction of a municipal dock and bulkhead to cost $20,000.

Dredging and Equipment, Miami, Fla.—The city will soon vote on $50,000 for the purchase of a bucket dredge, barge, gas towboat, etc. C. W. Murray is engineer.

Terminal, Charleston, S. C.—John P. Grace, mayor of the city, is interested in acquiring waterfront property for the purpose of constructing a terminal to be equipped with the most modern appliances, cranes, etc.

Bulkhead, Wharves, Etc., Covington, La.—The Fourth Ward of St. Tammany Parish will construct bulkheads and wharves and dredge harbor at Bayou Castaign, for which they have $25,000 bonds.

To Dredge Channel, Clearwater, Fla.—The Sunset Point Company has been organized with J. B. Discus, president, Chicago, Ill.; J. B. Paine, secretary and treasurer, Clearwater. The company will dredge the channel and basin from the main channel of Clearwater Harbor to the railroad.

Dock, Duluth, Minn.—The Inland Coal & Dock Company, 59th avenue, W., has awarded a contract for a 500-foot extension to their dock to R. C. Buck, Inc., United States National Bank Building, Superior, Wis. The estimated cost of the work is about $200,000.

Breakwater, Port Colbourne, Can.—The Department of Public Works, Paret Building, Ottawa, Can., let contract for repairing the breakwater to the Port Arthur Construction Company, Ltd., Excelsior Life Building, Toronto, involving an expenditure of about $55,000.

Produce Pier, Philadelphia, Pa.—Director Sproule of the Department of Wharves, Docks and Ferries, has suggested the construction of a produce pier, 80 feet wide and extending more than 150 feet into the river. At present no such pier is available within the central section of the river front.

Coal Terminal, Blakely Island, Ala.—Hampton Reynolds, of New Orleans, La., has received official notice that his bid of $100,000 for the construction of the Government coal terminal at Blakely Island has been accepted, construction of which must be completed in 150 days. Contracts for machinery to be installed are expected to be placed soon.

Drydock, Valparaiso, Chile—It is reported that contracts have been let by the Chilean Government for the construction of a drydock of 2,500 tons capacity. Concessions covering the new drydock extend over a period of thirty years, at the end of which time the Government shall have the right to purchase the dock and equipment.

Terminals, Nashville, Tenn.—A. J. Dyer, chairman of the Board of Transportation, let a contract to Foster & Creighton to construct concrete river and rail terminals, including a warehouse. The project involves the expenditure of $300,000. Freeland Roberts, Independent Life Building, is engineer.

Municipal Piers, Baltimore, Md.—The Port Development Commission purchased for $212,500 a tract adjoining the city's McComas street development, the site having 429 feet of water frontage, 1,400 feet deep, and contemplates the construction of groups of municipal piers. H. G. Perring is chief engineer, and Bancroft Hill harbor engineer.

Pier, Portland, Me.—According to Henry G. Merrill, chairman of the Port Directors of Maine, actual construction will soon start on the new 1,000-foot pier to be built at Portland, and for which the State has appropriated $1,500,000. The pier will be 1,000 feet long and 360 feet wide, with 35 feet of water alongside. The most modern freight-handling equipment will be installed. It is expected that the pier will be completed in a year.

To Improve Barge Canal, New York—According to a statement accredited to State Superintendent of Public Works Cadle, whatever can be done to improve the New York State Barge Canal facilities will be undertaken. The work of dredging the canal will be carried on vigorously with a view to maintaining a depth of 12 feet and arrangements have been made to lease extra equipment to facilitate the work. Electric cranes will be installed at all State owned terminals along the canal until the line is equipped. Steps will be taken to secure better coal handling facilities, thus eliminating the delays under the present methods.

Pier, Etc., Hayward's Creek, Mass.—Plans have been made for the construction of a pier for general business uses. At this point the Bethlehem Shipbuilding Corporation and the Massachusetts Oil Refining Company have recently made extensive improvements. On the opposite side of the river in Weymouth the Edison Electric Illuminating Company is understood to be planning extensive developments which have not as yet reached the contract period. The United States Government has just completed the dredging of the Malden River, and the Locke Coal Company and the Champlin-Hobbs Box Company are constructing wharves alongside the new channel.

Steel Contract Awarded, Chester, Pa.—A contract to furnish structural steel for a large grain elevator being erected by the New York Barge Canal Company at Gowanus Bay, Brooklyn, has been awarded the Merchant Shipbuilding Corporation, Chester, Pa., by the Segles Construction Company of Minneapolis, Minn. Awarding of the contract follows the announcement recently of the Merchant Shipbuilding Corporation that it was expanding its facilities to enter the structural and general engineering fields. The recent increase of contracts of this nature is believed to indicate a revival of activity in steel construction.

GOVERNMENT WORK

Machinery Installation, Oakland, Cal.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., having nearly completed the erection of a new ship fitters' shop at the Mare Island Navy Yard, will soon commence the installation of machinery in the various shops, including an angle shop, plate shop and forge and blacksmithing shops. A mold loft will be located over one of the bays.

Tanks, Chelsea, Mass.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., will soon receive bids for installing two new gasoline storage tanks and one new pump at the Naval Hospital.

Centrifugal Pumps, Etc., Point Isabel, Tex.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., will soon receive bids for furnishing and installing a motor-driven centrifugal pump and constructing a pump house.

Dredging—The United States Department of Engineers, J. Cyrille Dupont, will dredge 1½ miles connecting Bayou Black and Bayou Terrebonne, link of intercoastal canal from Houston to New Orleans.

Terminal Equipment, Birmingham, Ala.—The War Department, H. T. Bardeleven, manager of the Warrior River Section, Inland and Coastwise Service, 714 Brown Marx Building, let a contract to the American Hoist & Derrick Company, St. Paul, Minn., for the erection of an additional derrick in order to double the loading and unloading capacity of the port.

Dredging, New York—The United States Engineer Office, Room 710, Army Building, 39 Whitehall street, let a contract for dredging in Newtown Creek to the Columbia Dredging Corporation, 30 Church street, New York.

Breakwater, Indiana Harbor, Ind.—The United States Engineer Office, Milwaukee, Wis., has completed plans for the construction of the superstructure of the breakwater at Indiana Harbor, Ind., the foundation of which has already been laid. The sum of $4,000,000 will be expended for the completion of this project.

Breakwater—The Treasury Department, Washington, D. C., will receive bids until July 5, 1921, for the construction of a breakwater and placing riprap at Galveston, Texas. J. A. Wetmore is acting supervising architect.

Fire Alarm System—The Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids until July 6 for constructing additions to the fire alarm systems at Puget Sound, Washington.

Fire Alarm System—Specification 4470, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a fire alarm and watchman's signal system at New York City, N. Y.

Electric Traveling Platforms and Hoists.—Specification 1356, the Bureau of Yards and Docks, Navy Department, Washington, D. C., let a contract for constructing electric traveling platforms and hoists at the Naval Air Station, Lakehurst, N. J., to the Milwaukee Electric Crane & Manufacturing Company, Ind., Milwaukee, Wis., the work to be completed in 150 days at a cost of $34,000.

NEW INCORPORATIONS

The Inland Contracting & Wrecking Company, Wilmington, Del., has been incorporated, with a capital of $10,000, to reclaim sunken vessels, by John P. Cann, Henry McKeown and W. N. Tyson.

The Parkersburg Dry Docks, Transportation & Coal Company, Moundsville, W. Va., has been incorporated, with a capital of $250,000, by M. J. McQuade, J. R. Dorsey and others.

The Tri-State River Navigation Company, Columbus, Ga., has been incorporated, with a capital of $100,000.

The Whitaker Marine Construction Company, San Francisco, Cal., has been incorporated, with a capital of $25,000, by J. S. Whitaker, P. H. Whitaker, H. C. Mitchell, R. W. Gray, H. C. Wilson and L. F. Baker.

The Cranes' Shipyards, Ltd., North Vancouver, B. C., have been incorporated with a capital of $10,000 to carry on a business of shipbuilders, ship repairers, drydock owners, and operators and to own and operate ships of all kinds.

The Ocean Motorship Company, San Francisco, Cal., has been incorporated by W. E. Gerber, Jr., Ralph Roberg and C. N. Howard, all three affiliated with the Comyn interests. Arrangements have been made for the company to purchase the claim of the Australian Government for $1,625,000 against the Pacific Motorship Company for $125,000, thus eliminating the Commonwealth entirely from any interest in the eight wooden motorships and reducing their cost from $2,400,000 to $905,000.

Eastern Stevedores, Ltd., Montreal, Can., has been incorporated with an authorized capital of $50,000 to carry on a business as stevedore, shipowner, shipwright, wharfinger, etc., and general transportation, as well as to own and operate other ships of every description. The incorporators include J. McNaughton, J. G. Cartwright, J. V. Taylor, A. McIntyre and T. J. Griffin, all of Montreal.

The Midland Barge Company, East Liverpool, Ohio, has been incorporated with a capital of $100,000.

The Aliquippa Navigation Corporation, Dover, Del., has been incorporated with a capital of $100,000 for a freight and passenger transportation business by vessels.

The Anahuac Steamship Company, Inc., Manhattan, New York, has been organized with a capital of $100,000 to carry on a navigation business. R. L. Coffey, 59 Pearl street, New York City, is the incorporator.

The Bulk Fruit Steamship Corporation, 841 Calvert street, Baltimore, Md., has been incorporated by W. Ainsworth Parker, John G. Schilpp and John B. Diggs to carry on a steamship business.

The Houston Marine Engineering Works, Houston, Tex., has been incorporated with a capital of $32,000 by J. R. Giddens, R. R. Chamberlain and E. B. Davis.

The New York Canal and Great Lakes Corporation, Wilmington, Del., has been incorporated with a capital of $5,000,000 to own and operate boats.

The Palm Beach Steamship Line, West Palm Beach, Fla., has been organized with a capital of $75,000 to establish a steamship line from West Palm Beach to Jacksonville, Fla.

The Steamship Service Corporation, Dover, Del., has been incorporated with a capital of $100,000 to own and operate boats.

FOREIGN ACTIVITIES

Moreton Bay—The twin-screw geared turbine passenger and cargo ship Moreton Bay, built to the order of the Commonwealth Government Line of Steamers, was launched recently from the yards of Vickers Naval Construction Works, Barrow. Her length is 548 feet 9 inches, breadth molded 68 feet, depth molded 43 feet 6 inches, and her displacement is 23,120 tons. She was classed 100A-1 by Lloyd's and built to the requirements of the British Board of Trade, for passenger ships, and in addition complies with the Australian Navigation Act. The complete turbine installation is capable of developing a collective shaft horsepower of 9,000 with the revolution of the propeller shafts about 90 per minute. The main machinery consists of two sets of steam turbines of the reaction type. She has a speed of 15 knots.

Gouverneur General Chanzy—The twin-screw geared turbine steamer Gouverneur General Chanzy was launched on May 9th from the Birkenhead shipyard of Messrs. Cammell, Laird & Company, Ltd. She was built to the order of Le Commission aux Transport Maritime et a la Marine Marchande for the mail, passenger, and cargo service between Marseilles and Algiers. Her dimensions are: 377.6 feet by 53.1 feet by 29.33 feet, to carry 162 first class passengers, 84 second class and 56 third class passengers. The vessel has two sets of Parsons compound double reduction geared steam turbines.

Absina—The firm of Swan, Hunter & Wigham Richardson, Ltd., England, recently launched the twin-screw steamer Absina, which was built to the order of La Societe Generale de Transports Maritimes a Vapeur. She has a length of 470 feet, breadth 58 feet and a depth of 34 feet 3 inches. She will be capable of accommodating 94 first class passengers, 80 second class and 48 economic second class passengers. She is equipped with double reduction geared turbines of the Metropolitan Vickers Rateau type, constructed by the builders to burn coal or oil fuel under Howden's system of forced draught.

Eromauga—The Commonwealth Government steamer Eromauga was recently launched from the Walsh Island Dockyard. The vessel is of the Isherwood type, shelter-decked, with the bridge and poop decks extending the full length of the ship. She is built to conform in all respects to the provisions of the Navigation Act. She is 331 feet long, with a breadth of 47 feet 9 inches and a depth of 33 feet 7¾ inches. She is designed to carry a cargo of 6,000 tons and at full load has a displacement of 9,000 tons. She will be electrically lighted throughout. Power will be provided by steam generated in three watertube boilers of the Babcock & Wilcox type.

Steigerwald—The steamer Steigerwald, built for the Hamburg-American Line, was recently successfully launched from the yards of the Deutsche Werft, Germany. She is to replace a vessel of the same name which was lost during the war.

Flora—The Scheepswerf "Het Huis de Merwede" of Papendrecht have launched the steamer Flora, built for the Kon. Ned. Stoomboot Mij. of Amsterdam. She is a shelter-deck cargo steamer of 2,200 tons deadweight built to the highest class of the Bureau Veritas. She is 260 feet in length, beam molded, 39 feet, and a molded depth of 18 feet. The vessel will be equipped with triple expansion engines of 1,000 indicated horsepower, with cylinders 20 inches by 31 inches by 50 inches, with 36-inch stroke.

Dry Dock, Manila, P. I.—It is reported that a dry dock with a capacity for vessels up to 8,000 tons is to be constructed at Manila.

Shipyard Purchase, Scotstown, Scotland—It is officially announced that Sir Edward Mackay Edgar, Bt., of Messrs. Sperling & Company, is the purchaser of the Blythswood Shipbuilding Company, Scotstown. He is also a director of the Northumberland Shipbuilding Company, Ltd., William Doxford & Sons, Ltd., the Fairfield Shipbuilding & Engineering Company, Ltd., Workman, Clark & Company, Ltd., and the Monmouth Shipbuilding Company, Ltd.

Steam Trawlers, Nantes, France—The Societe Nouvelle des Pecheries a Vapeur of Arcachon has placed a contract with the Ateliers et Chantiers de Bretagne for two steam trawlers 184 feet in length, 29 feet beam and 16 feet in depth. These vessels are being built under the survey of the Bureau Veritas.

Naval Yard to Open, Nantes, France—It is reported that the new naval yards of Coueron are to be opened, and it is hoped that within a very short time the keel of the first cargo steamer to be built at this yard will be laid down. The vessel will be of the 4,500-ton Rhuys type.

Barges, France—The Forges et Chantiers de la Mediterranee have under construction three steel steam barges of the Vulcain type for the French Mercantile Marine Commission. The vessels will have a length overall of 148 feet 5 inches, beam 26 feet 4 inches and a depth to bridge of 13 feet 2 inches. The barges will be equipped with triple expansion engines having 480 indicated horsepower and will have a speed of 11 knots. Steel derricks, each capable of lifting 15 tons and operated by steam winches, will be placed on these barges.

To Improve Port of Marseilles, France—It is reported that Versailles port is to be further improved by the installation of new quays on the north bank of the Etang de Caronte. These are to be erected by a French combine including Fougerolle Freres and the Societe Marseillaise de Traffic Maritime. Port de Bouc improvements will also be undertaken and concern changes in the entrance channel and the dock, the filling up of the coves of Gaffette de Campeau and of Labillon, the broadening of the Marseilles-Rhone Canal along a stretch of 800 yards on the right of the Anse de Gaffette and the excavation of a new maneuvering dock on the south bank of the canal. Half the expense of these improvements will be borne by the Government. The huge floating dock to be built is estimated to cost about 123,000,000 francs.

Floating Docks, Dunkirk, France—An entirely new outer port is to be constructed here, according to the French Ministry of Public Works. Two floating docks are to be provided and there will be connection by canal with the naval repair yard on the As River.

Ferryboats, Docks, Etc., Havre, France—The French Ministry of Public Works is reported to have been authorized to proceed with the extension of the port of Havre. New docks will be constructed, an existing dock deepened and the quays enlarged, which should add some 12,000 feet to the existing wharves. The canal system is to be extended and the canal from Havre to Tancarville is to be widened and deepened. Communication between Havre and Rouen is to be improved, new ferryboats will be built, as well as additional warehouses to accommodate an increased quantity of goods.

Bill to Encourage Shipbuilding, Spain—A bill for the encouragement of Spanish shipbuilding introduced by the Minister of Commerce and Public Works provides that flag and import duties will be levied on all vessels built abroad, and customs duties on materials and fittings necessary for shipbuilding will be reduced. This reduction will be based on the condition of each of the national industries affected. In addition, during a period of ten years a bounty on a tonnage basis will be granted on vessels constructed during that period in Spanish yards or laid down six months before the expiration of the period. A bounty will also be granted to Spanish built vessels carrying a fixed quantity of Spanish products or material necessary for the national industries. The bill prohibits the sale abroad or the employment on non-national service of any vessel benefiting under the proposed scheme.

Hamburg-American Line Building Program, Germany—Plans have been made for the reconstruction of about one-third of the Hamburg-American Line's prewar fleet in the course of the next five years. This new fleet will consist largely of freight ships of from 5,000 to 12,000 tons deadweight. Some of the largest and fastest of these freight ships, which are suitable for the North Atlantic and the South American trade, will be equipped with a limited number of rooms for cabin passengers and a moderate capacity for third class passengers. Two large vessels of 22,000 tons gross have been ordered for the North Atlantic trade to carry first, second and third class passengers and a fair amount of cargo, and are expected to be ready about the spring of 1924. They will have a speed of about 16 knots. Most of the freighters will be equipped to burn either coal or oil fuel, and some will have reciprocating engines and some Diesel engines.

Shipbuilding Report, Germany—The report for 1920 of the Vulcan Werke of Hamburg and Stettin shows a gross profit of 12,617,783 marks, as compared with 6,318,951 marks for the previous year. The directors announce that the results for the year have been influenced favorably by the extensive and brisk dock and repair activities in both Hamburg and Stettin. Progress with new construction, however, is still slow and difficulty is experienced in obtaining contracts owing to the unfavorable impression created by labor unrest in the company's establishments.

New Tank Steamer, Japan—The steamer Tsurmi, a vessel of 8,000 tons capacity, is being constructed by the Osaka Iron Works for service in the oil carrying trade.

New Ferry Floats, Japan—The Japanese railway department has placed an order for two more railway car ferry floats with the Osaka Iron Works for the Shimonoseki-Moji service. These floats will cost 450,000 y.

New Dock for Shipyard, China—The Kiangnan Shipbuilding Yard, Shanghai, will build a new dock 500 feet long to the west of the arsenal.

To Improve Harbor, Japan—Y. 3,000,000 will be spent for reclamations in Sakai Harbor near Osaka.

Government Ships, Roumania—It is announced from Roumania, according to information received from Dr. Ing. Waldimir V. Mendl, naval architect of Braila, that the gunboat Mignonne has been bought from the French Government. The destroyers Sparviero and Nibbio, together with the Aquila and Falco which had been ordered for the Roumanian Navy before the war, were taken over by the Italians at the beginning of hostilities. Two of these boats have now been restituted. The other craft are former Austrian vessels allowed Roumania by the Conference of Ambassadors. Several monitors are already in Roumania after having been in Servian hands since the armistice and depleted of all valuable parts, necessitating very extensive repairs. Seven torpedo boats are in Venetia and have been taken over by Roumania and are being repaired by the Italian Navy Arsenal of this town. Two of them are already completed.

In the announcement of the new names for various ships of the Roumanian Navy, three monitors are named after new provinces, three torpedo boats are named after the various winds, four torpedo boats are named after former Roumanian warships, two destroyers are named after battles of the world war, and four gunboats are named after fallen officers.

BUSINESS NOTES

Edward A. Knowles, C. E. E. E., consulting engineer and fuel expert, has become associated with Murrie & Co., Inc., engineers, at 74 Broadway, New York, and is in charge of pulverized coal and gas fuel engineering work.

The C. H. Wheeler Manufacturing Company, of Philadelphia, Pa., manufacturers of condensers, pumps, etc., has opened a new branch office in Boston, Mass., located at 53 State street, Room 613.

It is announced that the autumn meeting of the Lyons Fair will be held from October 1 to October 15, next, in Lyons, France. The fair is believed to constitute an important manifestation for the promotion of international trade in the world. American manufacturers may receive information on application to Emile Garden at the New York office of the fair, 150 Nassau street.

Willard C. Brinton, president of the Terminal Engineering Company, Inc., manufacturers of the TEC truck, and varied material-handling machinery, announced that J. F. McGonigal, mechanical engineer, formerly of the Foamite Company, and J. H. Potter, machanical engineer, a graduate of New York University, have joined the organization. M. E. Lyle, for many years with the Columbia Graphophone Company, has been elected vice-president, and M. E. Peck has been elected secretary and assistant treasurer.

It is announced by the Page Steel & Wire Company that W. H. Bleecker, Jr., formerly district sales manager of the Chicago office will be transferred to the New York office, in the Grand Central Terminal, in the same capacity, and E. J. Flood has been appointed district sales manager for the Page products in the Chicago office, at 208 South LaSalle street, succeeding Mr. Bleecker.

It is announced that the New York office of the Canton Foundry & Machine Company, Canton, Ohio, has been established in new headquarters at 45 West 18th street. The company's sales exhibit office was formerly at the Grand Central Palace and is under the management of H. B. Bergere and L. Wechsler. The company's complete machinery line, comprising Canton portable cranes, Canton alligator shears, turn tables, etc., is now on display in the new quarters.

TRADE PUBLICATIONS

Steam Turbines for Mechanical Drive.—The application of the Curtis steam turbine for driving circulating and boiler feed pumps, as well as centrifugal pumps for all purposes, fans and blowers are described in detail in a bulletin recently issued by the General Electric Company, Schenectady, N. Y. The principles involved in the design of this turbine are summarized, including the wheel, shaft and buckets, casing, bearings, packing, governor, and other elements. This turbine may be used with slight changes for condensing or non-condensing operation, and may also be adapted to steam pressures ranging from 60 to 250 pounds.

Life Saving Equipment.—The steamship *Governor* which sank in eighteen minutes on the night of April 2, 1921, was equipped with modern life saving equipment which enabled all of the passengers and crew to leave the vessel without accident. The story of the disaster and the part Steward mechanical boat davits and deadrise metallic lifeboats played in the rescue work is told in an illustrated bulletin prepared by the Steward Davit and Equipment Corporation, New York.

Electric Drill Stands.—The Thor electric drill stand recently developed by the Independent Pneumatic Tool Company, Chicago, Ill., is intended for use with a wide range of drill sizes of the portable type, adapting them to work formerly done on drill presses. The details of the construction and methods of adjustment are given in a pamphlet sent out by this company.

Oxy-Acetylene Apparatus.—A review of the various forms of welding equipment produced by the Davis-Bournonville Company, Jersey City, N. J., is given in their latest descriptive bulletin. Acetylene generators, welding and cutting torches, pressure regulators and portable outfits are taken up in detail.

Steam Tables for Condenser Work.—The sixth edition of this work dealing with the condensation and evaporation of steam has just been sent out by the Wheeler Condenser and Engineering Company, Carteret, N. J. This book explains how measurements are made by means of the mercury column and barometer, and gives tables of constants and corrections for the thermal expansion of mercury and the brass scale, which allows the ready calculation of vacuums in inches of mercury. The values were specially calculated for the book by Professor Lionel S. Marks.

Receiver Type Separators.—The Griscom Russell Company, New York, has issued Bulletin 1140 containing a description of the Stratton steam separator, designed to remove water from the steam by the use of centrifugal force. Tabular specifications are given for each type separator and diagrams and photographs of typical installations.

The Strong Arm of Industry.—Examples of approved applications of electric hoists in practically every manufacturing industry are illustrated and described in a bulletin sent out by the Electric Hoist Manufacturing Association, New York.

Ventilators.—Application of the siphonage principle of ventilating buildings as accomplished by K-S-V ventilators is demonstrated in a catalogue issued by the Kernchen Company, Chicago, Ill. Illustrations and descriptions of typical installations are included in the book together with complete diagrams and specifications of the device.

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Shipping Board Makes Grave Mistake

As Marine Engineering goes to press the daily newspapers contain columns about the seizure by the United States Shipping Board Emergency Fleet Corporation of a number of boats turned over to the United States Mail Steamship Company to operate, including the *America,* scheduled to sail July 26, and the *George Washington,* due to leave for the other side on August 3.

The reason given by the United States Shipping Board for the seizure is that the United States Mail Steamship Company has failed to pay some $400,000 due for rentals of the boats. The counter contention by the steamship company is that it actually owes nothing, inasmuch as it has a just counter claim against the United States Shipping Board for a large sum of money paid out for reconditioning steamers for the account of the United States Shipping Board. The United States Mail Steamship Company further contends that the seizure was illegal in view of a certain contract between the company and the Shipping Board, which provides that disputes should be subjected to arbitration.

In view of the counter contentions and the probability that the whole matter will be thrown into the courts for adjudication, any discussion of the points involved would be out of order at this time. However, irrespective of the legality of the seizure or the justice or injustice to the United States Mail Steamship Company involved therein, the proceeding as carried out certainly reflects discredit on those responsible. Instead of an orderly procedure such as is common in the regular conduct of every established business, the United States Shipping Board went forth as a crusader with a blare of trumpets, a bevy of newspaper reporters and, we presume, the customary camera contingent, which resulted in long, front page articles with scareheads in a number of daily newspapers throughout the country—this at a time when substantially everyone concerned had his shoulder to the wheel trying to help the United States Shipping Board in its announced intention of putting and keeping the American flag on the high seas. At best there can be no real American Merchant Marine without hard fighting at every step. The deliberate and profuse publicity, which at least could easily have been obviated, cannot but tend to discourage the public from patronizing ships which fly the American flag and cause our attempt to compete with foreign ships to appear increasingly ludicrous in the eyes of people on the other side of the water. In view of the excellent progress made by the new Shipping Board in matters of reorganization and selection of experienced key men it is most unfortunate for the welfare of American shipping to have an action of this sort take place in the manner in which it did.

Port Facilities

Although shipping along with other industries is passing through a time of depression, it is most significant to note that large sums of money are being spent all over the country for improving harbors and expanding cargo handling facilities. This is encouraging not only because it will prevent a repetition of former times of embarrassing congestion and consequent loss of time and money, but because it shows so conclusively that the country has sufficient faith in the future of the shipping industry to spend large sums in preparation for the return of normal trade.

While the Port of New York for many reasons, both financial and geographical, handles at present about 50 percent of the export and import business of the country, the future development of our commerce will undoubtedly include all the American ports which are advantageously situated. Congress evidently had this in mind when it stipulated that the members of the Shipping Board should be chosen from specific geographical locations. Mr. Lasker, the chairman, also has this point of view for he recently stated that it was the purpose of the Board to act in partnership with all the ports, as well as with New York, to aid the development of American shipping.

But what is more significant, let us consider briefly a few important typical American ports. Seattle is rapidly increasing her port facilities, including an industrial canal connecting Lake Washington and Lake Union with Puget Sound, both lakes being large fresh water bodies well suited for extensive industrial development. San Francisco has almost unlimited natural facilities for expansion. Los Angeles recently voted a bond issue of $4,800,000 for all kinds of harbor development. Houston and Galveston are increasing their port facilities so fast that it is a question now if this district does not rank second as an exporting center. New Orleans, with its recently constructed deep water canal, has largely increased a waterfront already extensive. This canal makes a new outlet to the northeast, making it

possible to avoid the Mississippi Delta on northern routes. Baltimore is expending vast sums of money on harbor improvements, including a wide marginal way and modern terminals; and New York and Philadelphia have, as is well known, expended enormous efforts in developing war facilities.

And so we might go on naming individual projects where real money is being spent on the assumption that the total cost of transportation—rail and water—from interior points to foreign countries, will be the principal factor which will influence the movement of tonnage in the future. For the merchant marine these port developments are worth more than reams of paper arguments that business and capital have faith in the future of American shipping.

Support American Shipping

EVIDENCE that the interior sections of the country are still interested in the development of the American merchant marine was received recently by Chairman Lasker in a letter from the president of the Millers' National Federation. This organization at the Chicago convention unanimously reaffirmed the pledge it gave Admiral Benson several months ago to support our merchant marine and the Shipping Board. This is an important decision because the milling industry is the third largest exporter in point of bulk in this country and it can do a great deal in the way of providing tonnage for American bottoms.

Another organization, the Mississippi Valley Association, whose membership is composed of progressive business men from the twenty-seven states adjacent to the Mississippi and its tributaries, has recorded its resolution to support the merchant marine. The value of the support of this organization is two-fold, both practical and political; for it not only means the good will of business interests, but the representatives of these twenty-seven states which have a majority in both houses of Congress are bound to give consideration to the association's requests and suggestions.

In this connection the Mississippi Valley Association has passed a resolution favoring the full enforcement of the Merchant Marine Act of 1920, which would mean that shipping would get the same kind of support and protection that manufacturing and agriculture now have. It is very hard to see why any foreign country could object to a small preferential shipping duty to equalize the cost of the operation of vessels under the American flag and at the same time accept without the strongest protest the high custom duties which we are placing and propose to place on their products.

Vessels for Lighthouse Service

IN an editorial in the May issue of MARINE ENGINEERING we carefully explained the pressing necessity for new vessels for the Lighthouse Service. With twenty lightships over thirty years old and seventeen lighthouse tenders over twenty-five years old, and with one of these ships having reached the antique age of sixty-five years, it is evident that this important Bureau is performing its hazardous duties as a most important aid to navigation under very serious conditions.

In the latter part of June the Bath Iron Works, Ltd., was awarded a contract to build five lightships at a total cost of $920,000, a sum which last summer would have been sufficient to purchase only two and certainly not more than three of these ships. The next highest bidder, the Sun Shipbuilding Company, offered to build these five lightships for $975,000, which shows that reliable shipyards today are willing to accept contracts on a very small margin of profit—if any profit is possible at these figures—and at a price which the Government cannot hope to duplicate in the future.

The Lighthouse Service is a very efficient and deserving bureau. In addition to maintaining a vast number of lighthouses, lightships, buoys, fog horns and other aids to navigation, it is progressive and at present is doing some very good work with the radio compass, which is described on page 620 of this magazine.

Congress will appropriate for the coming year over three and a half billions of dollars. Would it not be good business economy from every standpoint to give this bureau a sum equal to less than one-thousandth of this appropriation for the additional vessels that it needs and which it should have had four or five years ago? It is nothing less than criminal negligence to permit these old ships to navigate in dangerous shoals which all other vessels evade. It is poor economy to keep them in commission because the repair bills are excessive and it is foolish to risk the wrecking of a liner costing several million dollars, to say nothing of the loss of lives, for a few $200,000 ships.

Superheated Steam

IN our present attempt to place American shipping permanently on the sea every means looking toward economy should receive proper consideration, and among them a prominent position can be accorded to the use of superheated steam. This is particularly true because European shipowners have been using superheated steam successfully for several years and ample proof that they have found it a means of securing greater efficiency and economy is shown by the fact that all the new Cunard liners are to be equipped with high degree superheaters.

In connection with the turbines installed in the new Cunard liners, it may be stated that this type of machinery is now well established for marine propulsion and there is no essential reason why it may not realize at sea the high degree of economy already common in land power stations. Steam turbines can realize the advantages of sufficient expansion and of a good vacuum; and steam turbine engineers, especially the English, are keen for superheating and claim that in practice they realize more than is promised by the theory of thermodynamics. While the average engineer is generally more impressed with results than theory, still at the same time this gain may be theoretically accounted for as a reduction in steam friction on the turbine blades.

A good marine engineer is a very important factor in the economical operation of a ship. He can do wonders with both the fuel and repair bills and in these days of fierce competition it is up to progressive shipowners and operators to give him every mechanical means of getting the maximum amount of power out of every pound of fuel that the boilers consume.

Why Has the Merchant Marine Act Been Nullified?

Failure to Enforce the Law Leaves American Overseas Shipping Absolutely Unprotected Against the Discriminations of Its Competitors

By Winthrop L. Marvin*

IT is now fourteen months since the Merchant Marine Act of 1920, the Jones law, was enacted and it is an ugly fact of undeniable significance that not one of the provisions intended by the authors of that measure to give positive protection and encouragement to American overseas shipping has been enforced. These provisions were deliberately ignored and nullified by President Wilson's Administration. I refer particularly to the provision of Section 23, that American owners of American ships be exempted from excess profits taxes on their ships operated in the foreign trade, if certain conditions are complied with; to Section 24, the requirement that all mails of the United States shipped or carried on vessels shall, if practicable, be shipped or carried on American-built vessels documented under the laws of the United States; to Section 34, directing the President within ninety days from the passage of the Act to give notice of the termination of treaties preventing the imposition of discriminating customs duties and tonnage dues on foreign vessels entering American ports; and to Section 28, reserving to American ships the carrying of those exports from and imports into this country which receive low preferential rates on American railroads.

There may be objections, there undoubtedly are objections in certain quarters, to the policy embodied in any or all of these provisions of the new Merchant Marine Law. It may be urged that any or all of them contravene the interests of our competitors in ocean trade. A considerable body of public opinion is undoubtedly averse to a revival of the early policy of discriminating customs duties and tonnage dues as a certain irritant to the governments of foreign countries.

But the hard fact remains that these provisions are the law of the land, enacted by a very great majority of Congress and duly approved by the Chief Executive. Every paragraph of the Merchant Marine Act of 1920 should have been honestly enforced in the spirit in which it was written, unless abandoned and repealed by the law-making authorities of the nation.

Other Federal Laws Inflexibly Enforced

This enforcement is the course that is inflexibly pursued with regard to other federal laws, even such as happen to be questioned and opposed by some elements of our population. Why were not these sections of the law obeyed and enforced in the present case, particularly Section 34, so clearly directing the President of the United States, "within ninety days after this Act becomes law," to take steps to terminate such parts of our commercial treaties as forbade the application of discriminating customs duties and tonnage dues? I am not urging that this would be the wisest and best policy for our merchant marine, or that application of it would be without risk, but the outstanding fact is that the Senate and House, exercising their constitutional right, directed the President to do this and he deliberately refused to do it. Technically, President Wilson could undoubtedly have been impeached for his declination to honor the plain mandate of a law which he had signed and approved, even though foreign governments objected to it.

Mr. Wilson could have asked Congress to repeal the provision if it were distasteful to him or menacing to the public peace and welfare. But he did not do so; he simply refused to enforce this section of the law exactly as his Treasury Department refused to frame the regulations for the enforcement of, and thereby deliberately nullified for the time being, the provisions of Section 23, exempting American ships in the foreign trade from excess profits taxation.

When the Merchant Marine Law was passed by such a commanding vote by Congress in the early days of June, 1920, and President Wilson signed it, the Act was hailed as a great triumph for the new American merchant marine. As a matter of fact, all the outstanding features of that law, so far as positive action is concerned, have been left a dead letter on the statute books though every other law that that Congress passed has been honestly respected and enforced by the executive departments of the government.

A great many years ago one Thomas Jefferson said:

"If particular nations grasp an undue share of our commerce * * * defensive and protective measures become necessary on the part of the nation whose marine resources are thus invaded; or it will be disarmed of its defence, its productions will be at the mercy of the nation which has possessed itself exclusively of the means of carrying them and its politics may be influenced by those who command its commerce."

Are Our Statesmen Afraid of Our Competitors?

Is it possible that our almost complete dependence upon foreign shipping in our country from 1865 to 1917 has given our competitors a subtle power so to influence American statesmen as to nullify American laws and that on this point America actually still remains in a state of Colonial servitude?

Unfolding of the policies of the new Administration must soon tell the story. Again I would emphasize that it makes no vital difference whether Section 34 relative to discriminating duties is a good provision of law or a bad provision. It is the law of the United States and President Harding must soon obey it or frankly ask for its cancellation. So, also, with the other positive provisions of the Merchant Marine Act which I have mentioned. They all must be either enforced or eliminated.

A great many of our public men and of our people believe that a carefully drawn subsidy policy, particularly based on the naval reserve, is wiser and more effective than a discriminating duty policy and would place our merchant marine on a more certain foundation. I do myself incline to that view. But it is essential that all those Americans who prefer another policy than discriminating duties, as well as those who advocate that expedient, should face the fact that any hostile influence in this country that can secure the nullification of one kind of shipping law once passed by Congress will also most certainly prevail to secure the nullification of another, unless a most emphatic protest is made by the shipowners and shipbuilders of this country and an aroused majority of the American people.

Time for the American People to Protest

It is full time that such a protest were made in tones of thunder. The American merchant marine, in spite of the brilliant promise of the law of 1920, is steadily, month by month, losing its control of even a part of our own American commerce. It is an ominous fact that cannot be denied and

*Vice-President and General Manager, American Steamship Owners' Association.

cannot be evaded. Official records of the government show that in April, 1921, only 37 percent of our imports was conveyed in American ships as against 41 percent in April, 1920, and that only 40 percent of our exports was conveyed in American ships as against 48 percent in April of 1920. Foreign vessels in April, 1921, carried 60 percent of our exports and 63 percent of our imports, or well nigh two-thirds of our international exchanges. Almost every month of the entire year has shown foreign shipowners strengthening their hold on the seaborne trade of the American people and a larger and larger proportion of American ships, government owned and privately owned, forced to quit the sea and to tie up at the docks or swing idly at anchor in our harbors. This process has continued until one-half of the Shipping Board steamers and more than one-fourth of privately owned American tonnage is now unemployed.

American Overseas Shipping Absolutely Unprotected

It is not the mere depression of trade that has done this. If it were, American vessels, available in large numbers, would still be carrying the same percentage of this lessened commerce as a year ago. American ships are being driven off the ocean because American overseas shipping, in spite of the vigorous provisions of the Jones law, remains an absolutely unprotected industry; unprotected against the cheap wages and the bounties, subsidies and powerful commercial discriminations of foreign lands.

A few months ago an American concern that had a contract for the transatlantic shipment of a large quantity of Southern cotton from a Gulf port was told that the British consignees of this cotton refused to receive it in any other than British bottoms or to have it insured in any other than British underwriting companies. This American shipping concern, therefore, had no alternative but to turn its American vessels back to the Shipping Board and charter British steamers because the cotton spinners of Lancashire, true to that spirit that has helped to make the British mercantile marine the greatest in the world, insisted on employing none but British carriers.

Another American shipping company, months ago, offered to bring to this country at substantially lower freight rates a quantity of Egyptian cotton purchased by and for the great mills of New England. But these American shipowners were bluntly told that they could not get a pound of it, that their ships must return empty to the United States because the British merchants who handled the Egyptian cotton crop had an exclusive contract with the British steamship conference, which precluded the use of American ships.

Aggressive Discrimination Against American Ships

These typical instances show one aggressive discrimination which American ships are up against in their efforts to secure for our country and its flag a fair share of the carrying of our country's commerce. But there are other and grave obstacles in the higher wage and living standards of the personnel of our merchant marine in this initial stage of its development. The payroll of officers and men of an American steamer of 9,000 tons deadweight is from $1,000 to $1,500 a month above the payroll of a British or Norwegian ship of like capacity. It is true, as is often asserted, that except our own, British steamers pay the highest wages in the world; substantially higher than the wages of Italians, Greeks, Spaniards or Japanese. But the old, firmly established British mercantile marine enjoys a compensation for its higher wage scale in the complete, intensive British commercial combination which girds the world, of which this Southern cotton case and the Egyptian cotton case just cited are examples. This great world-round British combination insistently prefers and works for the interests of British ships. There is not yet, nor is there soon likely to be, a similar American combination for American ships.

In view of these circumstances only one thing can possibly save our own merchant marine in the losing fight which it is waging, and that is the aggressive backing of American manufacturers and merchants and of the American government. It is no mere boy's play, no holiday rose-tossing, this maritime rivalry on which our ships have entered. It is a grim, dogged encounter in which our competitors cherish few scruples and show no grace. They will beat us if they can and destroy us on the ocean as they did in the merciless rivalry of the decade before and the half century after our Civil War. If rival governments are strong enough in the United States, by diplomatic protest or commercial and political influence, to prevent the enforcement of the most aggressive provisions of the Merchant Marine Act of 1920 as they manifestly were throughout the Wilson Administration, they will be strong enough, unless the American people are thoroughly aroused to action, to nullify similarly any further laws which the Harding Administration may receive from a Republican Congress.

No miracles will in themselves be worked by a mere change of political control in Washington. A great majority of the American people believe in the patriotism and courage of the present National Administration. They demonstrated this by preferring it to a continuance of the rather uncertain control under which the nation had lived for eight trying years. But this great popular majority must make up its mind to stand by President Harding and the commissioners of his new Shipping Board, and loyally hold up their hands, if this present heart-breaking decline of our new merchant marine is to be checked and another crushing national disaster be averted.

Progress of Shipping Legislation

There has been little activity in Congress during the past month on legislation relating to shipping, as Congress is settling down to the special objects for which it was called in extraordinary session, namely, taxation and tariff legislation. Senator Cummins has introduced in the Senate a bill, S. 2203, to establish a government ship line between United States and Alaska to connect with the government railroad in that territory. The bill, S. 745, providing for workmen's compensation for maritime workers was passed by the Senate on June 10 and referred to the House committee on judiciary, which has not yet acted upon it. The Scott bill, H.R. 6754, to afford relief to passenger and package boats on the Great Lakes by modifying the requirements of the La Follette seamen's act as to working conditions for crews on vessels on the Great Lakes, has been passed by the House and referred to the Senate committee on commerce. The bill, H.R. 6775, to regulate marine insurance in the District of Columbia, was favorably reported without amendment from the House committee on the District of Columbia on June 21 and has been placed on the calendar of the House. Senator Borah's bill, S. 665, to allow coastwise shipping to use the Panama Canal without the payment of tolls, has been reported to the Senate but has not been acted upon.

The conference report on the Naval appropriation bill, carrying about $410,000,000, was adopted by both houses of Congress on July 11 and signed by the President on the following day.

The sub-committee on marine insurance of the House Committee on Merchant Marine and Fisheries has been directed by the committee to investigate the causes for substantial increases in the loss of shipments on vessels through pilferage, breakage and short cargoes, which have been reported to the committee. The object of the investigation will be to ascertain, if possible, methods for cutting down the losses. The sub-committee plans to hold hearings in the near future.

Reorganization of the Shipping Board

Three Main Objectives, Disposition of Government Vessels, Operation of Government Vessels and Settlement of Claims

By Waldon Fawcett

ELOQUENT not so much of the evolution of new policies as of a new determination promptly to carry into effect administrative policies, long standing or foreordained, is the reorganization of the United States Shipping Board under the direction of Chairman Albert D. Lasker. Appointed to his new post on his reputation as an executive capable of quick accomplishment, the transplanted head of a great advertising agency had no sooner surveyed his new responsibilities than he gave warning that an impatient public must not expect instantaneous results. Although it might appear to the layman, looking on, that the entire time since the signing of the armistice has been occupied in official "investigations" of the Shipping Board and its operations, the new head of the institution may find justification for his claim that the new management must make careful survey of the situation that confronts it, ere it can act.

From the standpoint of the shipping and shipbuilding interests of the United States and of the world, curiosity as to the future course of the Shipping Board has three main objectives; that is to say, three lines of policy affecting practical maritime affairs are in the balance. With the interior organization of the Shipping Board, shipping men are but remotely or indirectly concerned. The problem of the reduction of the clerical force of the Board, regarding which official Washington has been so deeply exercised, and even the supposed scandals of maladministration, have relatively little significance for the men who construct and operate ships. The labor policy of the Shipping Board is of consequence, to be sure, because of its influence upon the labor situation in the private shipping field, but three fundamentals of Shipping Board policy must inevitably focus the attention of the maritime community.

Three Main Objectives

The first of these is the policy to be pursued in the disposition of the surplus vessel property of the United States, acquired during the war emergency. The second is the policy that is to obtain in the operation of the ships that are to continue permanently or indefinitely under government ownership or control. Third is the policy that will prevail with respect to the settlement of the vast aggregate of claims for commodities and service of every description that have remained unadjusted since the end of the war or the completion of war-time contracts. Because virtual inaction or indecision on at least two out of three general responsibilities above enumerated has characterized the regime of the Shipping Board awaiting reorganization there is a temptation to hail any determination as a new policy. Actually, though, the newly appointed Board will but energize a program that was a foregone conclusion.

This is particularly true with respect to the disposition of that large proportion of the governmental fleet which has no profitable employment. It was a foregone conclusion that, sooner or later, Uncle Sam must place on the auction block the heavy accumulation of tonnage, the value of much of which has been shrinking day by day. But administrators, appalled by the losses already incurred in the shipbuilding venture of the United States, have hesitated at the major operation of writing off the immense depreciation that must be charged to the war. The new administration, faithful to a platform that calls for the withdrawal of the government, has at least had the courage to decree the sale, for what it will bring, of the idle and useless tonnage that to the tune of millions of deadweight tons has been tied up for months past.

Time Required to Dispose of Fleet

With the best intent in the world the Shipping Board will be unable, according to qualified, practical men, to dispose of the fleet in less than two or three years. The orderly processes of execution will require time even in the case of tonnage such as the wooden freighters of which the government desires to be rid as speedily as possible. Furthermore, there is to be reckoned with a class of modern, serviceable steel tonnage which may not consistently be sacrificed to bidders merely out of a desire to wipe the slate clean. The new Shipping Board will make every effort to dispose of its steel tonnage as expeditiously as may be but, if it appears that the stagnation of commerce and the depression in the shipping industry have demoralized the market for vessel property, it will be the policy to bide time for a reasonable interval in the hope that there may be a return to something approaching normal status.

For all the determination of the reorganized Shipping Board to get action wherever action is possible it seems likely to find, ere long, that it is beyond its power to effect the sale of the Government's ships even though it place them on the bargain counter. With the spectacle of 685 steel ships tied up at a cost of approximately $900 per month per ship and 274 wooden ships tied up at an expense of $100 a month per ship it has appeared to many of the taxpayers of the country that heroic measures were justified to get rid of the encumbrance. In reality, however, the sales division of the Shipping Board has not sat with hands folded while the value of the fleet was whittled away.

Efforts to Sell Wooden Ships

For months past effort has been made to sell the wooden ships at virtually any price the market would afford but with limited success. The ships have been advertised abroad and a "sample ship" was sent to Naples in an effort to interest foreign purchasers in this class of tonnage. Meanwhile, American purchasers have virtually declined to touch the proposition because the high cost of operation of wooden vessels as compared with steel vessels rendered it problematical whether any profit could be earned. The question has often been asked by critics of procrastination why the Shipping Board did not, months ago, sell its surplus craft and particularly the wooden vessels for what they would bring.

Inasmuch as the reorganized Shipping Board is to be driven to this extremity, after millions of dollars have been expended for upkeep, the question is an appropriate one. The answer is that the sales division of the Shipping Board, alike to many another victim of a falling market, was always a bit behind the recession in the readjustment of prices. For example, the Shipping Board had been getting from $30,000 to $35,000 for wooden hulls on the Atlantic Coast and accordingly it scorned tentative offers of $8,000 to $10,000 for similar hulls on the Pacific. There was talk of towing some of the hulls from the west coast to the east coast to find a better market but meanwhile the market went from bad to worse, leaving the Board with some seventy-five hulls on the west coast. Thus it was only by the gradual

persuasion of the inevitable that the executives at the head of the sales division came to the point where they realized that it was the lesser of two evils to sell wooden hulls at $10,000 and steel tonnage at $40 to $55 per ton, if responsible customers could be found.

Deferred Payments on Pioneer Sales

No less disturbing in the sale situation, though all unrealized by the great majority of outsiders, is the crisis that has developed with respect to payment for the vessels which have been sold on the deferred payment plan. The indebtedness from ship sales, etc., exceeds $17,000,000 and presents one of the most perplexing problems that the new Shipping Board finds on its doorstep. The gravity of the situation may be surmised from a recent confidential statement by Mr. Philbin, of the division of sales, that in his opinion unless some adjustment of prices is made every vessel that has been sold by the Shipping Board on a partial payment plan will be returned to the Board.

To visualize the situation with respect to payments on ships, it is necessary to bear in mind that the Shipping Board in the beginning undertook to sell ships on three or four different plans of deferred payments. In many instances the payments were based on the earning conditions which then obtained and which were such as to suggest that a vessel would earn its purchase price in a comparatively brief space of time. A number of the purchasers had paid anywhere from 25 to 40 percent of the purchase price when they were hit by the slump induced by the scarcity of cargoes and falling freight rates. In the face of the collapse it has been virtually impossible for the shipping men who are in this predicament to meet their obligations. The Shipping Board has brought to bear, for the collection of the outstanding $17,000,000, such pressure as it dare apply but always it has been restrained and the new Board will have to continue to be restrained by that moderation disregard of which would discredit shipping securities and invite the demoralization of the entire shipping industry.

It is conceded by the sales executives of the Shipping Board that many of the small shipping companies that began business during the war or immediately afterward and purchased vessels from the Shipping Board are no longer solvent, their assets having been wiped out in the continued operation of the vessels under the present conditions. The companies that are solvent are unanimous in appeal to the Shipping Board to readjust prices in order that they may secure their equities. A number of ship sale cases have been referred by the Shipping Board to the United States Department of Justice. However, officials in the sales division who are familiar with all the circumstances of the transactions say privately that they think it highly questionable whether any moneys can be recovered for non-performance of purchase contracts or any satisfaction obtained via foreclosure under mortgage because of the depreciation of marine securities which necessarily has direct relation to the valuation placed upon vessels and to their paper assets. It has been demonstrated that it would be to the advantage of the average purchaser, who is in this plight, if he could have his contract annulled and re-purchase his vessels at the new prices to be fixed by the Shipping Board.

Arbitration of Claims

Most promising of results in the proclaimed policies of the reorganized Shipping Board is that which will seek to dispose by arbitration of the claims against the Board, arising out of cancellation of contracts, etc., and which amount in the aggregate to more than $300,000,000. The presence on the board of arbitrators of a practical shipping man is expected to safeguard the interests of claimants in even greater degree, perhaps, than was possible when the Shipping Board appeared in the dual role of judge and defendant.

No inconsiderable proportion of the pending claims are of foreign origin. Included in the number are the Norwegian claims which have been the subject of much discussion and the arbitration of which is provided for by the agreement between the United States and Norway which was lately sent to the United States Senate for ratification. There are payments due on the vessels under construction in China, and there are claims by Japanese steamship operators aggregating about $600,000. This last is a relatively small amount and the fact that settlement has not been made is explained by the inability of the Shipping Board auditors to make, to date, an examination of the accounts of the Japanese ship operators. The claims embody excessive time allowances for the employees on board the ships during the time they were within the war zone and it is the desire of the Shipping Board to check up on this. Set over against the claims against the Shipping Board by foreign countries or alien subjects, the Board has certain accounts to collect from foreign powers, notably the $12,000,000 due from the British government for the transportation of fuel oil.

Able Shipping Man for Director of Operations

The first confession of consternation over the magnitude of his new task which came from the new chairman of the Shipping Board took the form of an expression of determination to draft for the division of operations the ablest practical shipping executives that could be obtained and to pay in these positions salaries sufficient to compensate men of this caliber. The reorganized Board's policy of ship operation is one policy that is in a state of flux. It will not be surprising if it undergoes, during the next few months, not one but a number of revisions, each more or less radical. This is due to the fact that there is the sharpest divergence between the policy of ship allocation, which has heretofore been followed by the Shipping Board, and the "bare boat" charter system which is favored by so many private ship operators. It is urged by members of the American Steamship Owners' Association that the bare boat charter system would enable the Shipping Board to curtail to a considerable extent the heavy overhead with which it has been burdened and that its adoption would be a logical initial step in the transfer of the entire Government fleet to private ownership.

It has been customary, in describing the routine that has heretofore been followed by the division of operations, to say that the Shipping Board, in execution of a policy of allocation, has granted or executed charters. This is not an entirely accurate designation. The bulk of the Shipping Board's vessel now in commission has been placed in the hands of managing agents under an agreement called a managing agent's agreement. At last account there was on the roster an aggregate of 83 managing agents of cargo steamers, 7 tugboat operators and 3 tank steamer operators. Included among the managing agents are old-established steamship companies which operate vessels of their own as well as Shipping Board tonnage. Likewise there are companies that have been formed for the purpose of operating Shipping Board vessels. All told, the managing agents had in operation, at the latest date of computation, 621 ships. The managing agent is, of course, paid a commission on the gross revenue of each ship regardless of whether or not the ship operation shows a profit. Different percentages apply to different classes of cargo. On a cargo of one commodity, loaded at a single port, the allowance has been 2.5 percent of the gross freight list whereas on a ship carrying general cargo, covered by numerous bills of lading, the commission has been 5 percent. This scale has prevailed though the income of the cargo ships has been equalled or exceeded by the actual cost of operation, save, of course, with cattle ships and refrigerator ships which have, in the deepest dip of the depression, earned small profits.

(*Concluded on page* 589)

Future Policy of the Shipping Board

Shipowners and Operators to Co-operate—Mr. Lasker Given Authority to Draft Best Brains for Key Men

By Harold F. Lane

A NEW plan of organization for the United States Shipping Board was announced on July 11 by chairman A. D. Lasker by which the Emergency Fleet Corporation will be revived to operate the government-owned ships, with members of the board as trustees and Chairman Lasker as president, and with a practical operating board consisting of five vice presidents who will be given full authority subject only to the decisions of the Shipping Board on questions of policy. The vice presidents will proceed to reorganize the departments under them.

Mr. Lasker announced the appointment of three vice presidents in charge of operations, J. Barston Smull, of the firm of J. H. Winchester & Company, ship brokers, New York; William J. Love, until recently manager in New York for Furness, Withy & Comany, Ltd., of Great Britain, and A. J. Frey, general manager of the Los Angeles Steamship Company. They will have charge of the allocation and chartering of ships, traffic and physical operation, but the exact division of their duties has not yet been determined upon. Elmer Schlessinger, general counsel of the Shipping Board, will also be a vice-president of the Fleet Corporation and Chairman Lasker went to New York on July 12 to select a vice president in charge of ship sales and salvage. There will be a new treasurer and Alonzo Tweedale will remain as general comptroller, while R. H. Montgomery will represent the chairman and the board in making a complete reorganization of the auditing system and an inventory of the assets of the board, which it is hoped to complete within 60 to 90 days. Clifford W. Smith, who has been connected with the Associated Press, has been appointed secretary of the board and of the Fleet Corporation, succeeding John J. Flaherty. W. B. Keene, the present acting director of operations, will remain in the operating department.

Authority for Reorganization

The plan of organization was unanimously adopted by the board and approved in detail by the President. Under the Jones act there is authority for the use of the Emergency Fleet Corporation but there is a question as to its status if the president issues a proclamation terminating the technical state of war. However, the President has promised that if it becomes necessary he will undertake to obtain from Congress the legislation required.

In making the announcement to the Washington correspondents Chairman Lasker took occasion to discuss in considerable detail the policy of the Board, which proposes to function in such a way as to turn the operation of the ships over to private enterprise as soon as practicable.

"We have $300,000,000 in law suits and claims, which, of course, we will undertake to defend in such manner as to see that the government is protected and every claimant receives his dues," Mr. Lasker said. "We have scores of millions of property to salvage, and we will undertake to do that in such a way and at such a time that we will get its true worth. But, hypothetically speaking, if we gave away the salvage and if we lost all the law suits, the money cost would be measured and not continued. It would be the total amount already invested. But operations is another matter. The loss there cannot be measured; unless corrective measures are applied it would be continual and unending. And again, unless operations should be done efficiently, the American merchant marine will never be established on the high seas. So that while law suits and salvage can cost the Treasury a great deal of money if not efficiently done, in the end it has nothing to do with the successful operation of the fleet. All in all it is the success or failure of operations that will furnish the final answer.

Spirit of Cooperation

"The Shipowners' Association of America and the Ship Operators' Association of America have shown the most magnificent spirit of cooperation with the new Shipping Board, and have by evidence proved to the new Shipping Board that they want to enter into a true partnership with it for the upbuilding of the American merchant marine. The ones who know best how to operate ships are the owners and operators, and they were unanimous in the recommendation that ship operations should be under one man. But it seemed otherwise to the board, because the operations of the fleet under its control are so infinitely greater than anything ever undertaken by other men, that the mere experience of the past could not be a sure guide to the future. The biggest privately owned fleet known today has, I think, 107 ships in it. Leaving out the wooden boats, we have 1,440 ships. It is no secret that our business and organization are not in smooth running condition; and no one man could possibly solve the problems presented, both because of lack of time and because they present such diversified problems that no one mind could grapple with them.

"We asked the shipping world to recommend the best talent to us for the positions determined upon, and told them we would take no one save those recommended by them, though we did not promise to take the first, second or third that they recommended; and we would only take outsiders if they utterly failed to present to us men whom we could accept. I met with the men recommended by them, every one of whom came believing in one man for operations; and with one exception, after we showed our situation to this man, you could not have gotten that man to come if he was to be the only man.

Three Men Selected

"Mr. Smull is a half owner in one of the largest, if not the largest, ship brokerage firms in America. His firm has an income of about $500,000 a year, and his share is $250,000. He was the unanimous choice of the shipowners' and ship operators' associations for the position of chief of operations of the fleet, and to a man every shipowner and operator described him as the only man they could agree on to operate the fleet. I remained for 12 days in New York with Mr. Smull, getting his refusal day after day, and day after day telling him, 'They have convinced me that you are the man who, if associated with us, will make the promise of success pretty sure, and without you I don't think we can succeed.' He not only has the confidence of owners and operators, but shippers as well, because he is known to every shipper. He was chairman of the chartering committee of the American ships during the war, and throughout the world it was recognized as the finest piece of chartering work done in any of the allied countries. Day after day, because of the great length of time he had given to the government before and during the war, and because of present conditions in his own busi-

ness, he refused to come. But on Saturday he yielded, on condition that he was satisfied with his interview with the board and the President; and he was satisfied. They put up to us several alternate men if we could not get Mr. Smull, but none of these alternate men had a unanimous vote. After I met Mr. Smull I became convinced that he was in every way an ideal man.

"Mr. Love, I might say, was the unanimous choice of the ship operators, and when he was selected, the shipowners joined in feeling that he and Mr. Smull represented the best that the eastern seaboard could put forward. Mr. Love is the New York manager of the largest British firm doing business in this country. He is an American citizen, born in America, and considered possibly the best expert in this country on traffic matters in connection with ships, and knows conditions throughout the United States and the world, particularly how the British have operated their merchant fleets so successfully.

"From the West we have selected Mr. A. J. Frey, who was assistant to the president of the Pacific Mail Company when it had its large fleet, and at that time was the most successfully operated American-owned concern.

To Have Free Hand

"The work will be divided among these three vice presidents, and the policies in connection with the operating, chartering and disposal of ships will be initiated by them to the board. The board has invited them in on the basis of an absolutely free hand in the operation of the boats after a policy shall have been decided, and they have the assurance of the board and the President that there will be no political interference of any nature. The President has urged upon them the absolute necessity of operating these boats on the basis that they represent all the stockholders, who are all the people of the United States, and that efficiency alone, and that which lends to efficiency, should be compelling in their decisions on personnel and on their actions.

"The President and the board feel greatly encouraged that men of the type announced have accepted these appointments. The sacrifice, such as Mr. Smull for instance is making, is beyond measure. The sacrifice Mr. Love and Mr. Frey are making in leaving their well-ordered business is the best evidence that we can get the best brains of the country into the operation of the Shipping Board; and the Shipping Board cannot excuse itself for failure, if it does fail, on the ground that it cannot get around it the highest type of men able to do the work. If we fall down in that direction it will be our own fault, and there will be no chance for an alibi. It will take a year of the hardest kind of work and of the most efficient kind of work to bring the first semblance of order out of the chaos that exists. But we do not only feel hopeful and encouraged; we feel that the coming to us at such sacrifices of these men and other men with whom we are negotiating leaves us every reason to believe that the best ideals concerning the American merchant marine can, with patience on the part of the public and Congress, come to be a permanent reality.

Salaries and Duties

"As to salaries, the three operating vice presidents will get between them a total of $95,000, which will be divided approximately equally. The operating headquarters will be in Washington. Where we have branch offices each vice president will select his own district manager, who will be attached to the branch office, but the general manager for each branch office will be selected by all the vice presidents. Each vice president will have sole control of the selection of all the men under him. It has not been determined how operations will be divided, but Mr. Smull may have allocation and chartering of ships; Mr. Love, traffic, and Mr. Frey have physical operations. Each will select his own men.

"The Shipping Board loses no control whatsoever as contemplated by the law. All the policies must be initiated by those men and submitted to the Shipping Board for the Shipping Board to adopt. But, once adopted, these men will have a free hand in their execution. Each operative head will be in charge of a certain character of work, but they may change it into territories. When it comes, however, to making recommendations for policies, the three will have to be in agreement. We are undertaking to make them as free in the management as if they held similar capacities with any big corporation.

Key Men Available on Request

"The President, the Jones Act and the Shipping Board are all in accord that the Shipping Board must function so as to turn these boats over, as soon as good business judgment dictates, to private owners. Unless Shipping Board boats are very soon operated along the most correct business lines, we will not have any operators or owners left in America who can buy these boats. The operators and owners unanimously feel that way; and to get Shipping Board operations on an efficient basis is the quickest and shortest step to creating a situation whereby private people can buy these boats and get the government out of government ownership. It is for that reason that the shipowners and operators have unanimously agreed to something which I think is unique in government relations with private industry—that if they have any key men whom we want and who are vital to them, but who are vital to us, we are to get these key men on request, and they are not to let us know that it is a calamity to them.

"New routes will be one of the assets we will try to sell. Another phase is this: Supposing there is a route and two ships are on it, one privately owned and one government owned, and it will only stand for one ship. It is our idea that we will take out of service the government-owned boat and leave in the privately-owned boat, because if we bust the private company, whom will we have left to buy the boats when business gets good enough to have two lines?

"The appointment of Messrs. Smull, Love and Frey will mean a new day in the minds of shippers, and you don't want to forget that in this equation. Shippers have lost confidence in the government-owned ships. They have not sailed on time, they have not arrived on time, and the goods have not always been in good condition when they have arrived. By the time they get the answer as to whether we will charter them a ship, that business is often loaded in foreign bottoms. The coming of Smull, Love and Frey will give a wholly different atmosphere to American shippers. They will know it will not change the next day. And there is not a shipper who does not know these names as a music lover knows Caruso or a baseball lover knows Babe Ruth. And they will know that these men will do it; and that is what we mean when we say that through efficiency we will build up an American merchant marine."

President Harding has submitted to the Senate an arbitration agreement providing for the adjustment of claims of Norwegians against the Shipping Board aggregating $14,157,000 for 15 vessels taken over by the board during the war. The vessels were being constructed in American yards for Norwegians when they were requisitioned. The claims were taken up by the Norwegian Government through diplomatic channels after the claimants and the Emergency Fleet Corporation had failed to reach an agreement.

* * *

The Shipping Board in response to appeals from the Wisconsin Legislature and states on the Great Lakes has delegated Commissioners O'Connor, Benson and Plummer to make an investigation of the operation of package freight boats on the Great Lakes.

British Frozen Meat Cargo Steamer Tairoa

This article describes in detail the method of insulating a meat refrigerator vessel with silicate cotton and cow hair as practiced at the works of Sir W. G. Armstrong Whitworth & Company, Ltd., Newcastle-on-Tyne, England. The "Tairoa" represents a class of vessel of which there is at present a shortage in the American merchant marine.

THE *Tairoa* is a shelter deck type of vessel with a combined bridge and poop and a topgallant forecastle. Three decks are fitted, the second or main deck extending from stem to stern except in way of machinery spaces and the upper and shelter decks are continuous the full length of the vessel. The main propelling machinery is located in two compartments amidships and consists of two surface condensing, vertical, quadruple expansion engines of 5,000 indicated horsepower. Steam is generated in four cylindrical boilers, two being of the single ended and two of the double ended type.

Five main cargo holds are provided, three forward of the machinery spaces and two aft. Holds Nos. 1, 2, 4 and 5, with their adjacent 'tween deck spaces between the upper and second decks, are insulated for the carriage of refrigerated cargo and cooled by an installation of the brine pipe system of CO_2 refrigeration.

The particulars of the insulation fitted are as follows:

Material

The insulating material is silicate cotton of best quality with washed cow hair in certain portions. All grounds are of best quality white deal, coamings and all framings of pitch pine and the matching throughout of white deal of good quality. The matching is tongued and grooved but not beaded.

Bottom Insulation

Angles 4 inches by 3 inches with the large flange vertical are riveted to the tank covering plate, 3 inches inboard from the line of limbers, on each side for the complete length of the hold and calked watertight. After fitting, these angles and the tank top were coated with ½ inch of Wailes Dove's bitumastic cement. Coamings 2½ inches thick of suitable depth are securely bolted to these angle bars and between these coamings, across the tank top, grounds 8 inches by 3 inches are laid over each floor. In way of the hatchways, and extending two floor spaces beyond the hatch at each end, intermediate grounds are laid. On the top of these grounds two thicknesses of white matching, 1 inch and 1½ inch respectively, are nailed and underneath the hatchways seasoned elm doubling 2 inches thick is spiked down, extending in Nos. 1 and 2 holds 2 feet further in each direction than the hatchway above, the edges being chamfered and the seams calked and payed with marine glue.

In Nos. 4 and 5 holds the doubling extends between the tunnels to the forward bulkhead and is carried over the tunnel grounds and 4 feet on the floor from the outer side of each tunnel.

Turn of Bilge

Grounds 3 inches by 2 inches are bolted on the face of each floor and are carried up as far as the first stringer. Over these are nailed two thicknesses of 1¼ inch white matching with grounds 5 inches high by 3 inches thick in line with each floor and covered over with two linings of 1 inch and 1½ inch respectively, the space between being packed with silicate.

Bilge Scuppers

The trap scupper is fitted through the end bilge hatches, on each side, in each insulated hold. The scupper is arranged vertically in the bilge 1 inch clear of the grounds when the hatch is in position, a wooden cage being built over the top of each scupper.

Limber Hatches

A double line of limber hatches is fitted fore and aft in each compartment, also thwartship hatches between the tunnels in way of scupper pipes, etc., in Nos. 4 and 5 holds. Those into the bilges have a clear opening of 1 foot 9 inches and are constructed as follows:

The sides of 2 inches, the top and bottom of 1¼ inch and 1 inch respectively and the inner linings of ¾ inch, the coamings 2½ inch thick, each hatch being filled with 5 inches of washed cow hair. These hatches, which in no case exceed two frame spaces in length, are fitted with 2 inches by 5 inches stiffening grounds, one in the center and one in way of each ring bolt. Each stretch has three key hatches and a plug in the bulkhead to give access to the end bays. Each hatch has two ¾ inch galvanized iron ring bolts and nuts secured through stout washers with an oval hole in the top washer to permit the ring to lie flat on the hatch. Grating hatches of heavy material and Troop pattern are supplied, being fitted in way of all cargo hatches for ventilating purposes.

Manhole Openings

Around each manhole a 4 inch by 3 inch angle bar with welded corners is riveted down to the tank top and calked watertight. Frame coamings 2½ inches thick and of suitable depth are securely bolted to the underside of the angle bar into which are fitted hatches similar in construction to those specified for limbers.

Tunnel Recess

Top sides and end are fitted with grounds, etc., and insulated with 12 inches of silicate in a manner similar to the bulkhead adjoining, but the covering boards are each 1¼ inch matching.

Tunnels

Grounds 10 inches deep by 3 inches thick were cut to the sweep of the tunnel and attached with ¾ inch bolts to the stiffeners. To these are secured two thicknesses of 1¼ inch matching, breaking joints, the intervening space being tightly packed with silicate cotton. A portable strake 12 inches wide on the crown of the tunnel is fitted for sight purposes, secured in place with stout brass screws. American elm hoops 2½ inches by 2½ inches bent to shape and having the upper edges chamfered are secured round the tunnel spaced 9 inches apart. Elm chafing blocks, spaced 20 inches between centers, 3 inches thick and of sufficient depth to protect the brine grids are securely fastened to the side of the tunnel.

Side Insulation

Grounds 3 inches by 2 inches thick are bolted to the face of the channel frames, these grounds being well bedded on thickly painted tarred felt and secured in place with ⅝ inch bolts spaced not more than 3 feet 6 inches apart. On the face of the grounds two thicknesses of matching ¾ inch and 1 inch respectively are nailed, the space between the boarding being tightly packed with silicate cotton. The first stringer above the turn of the bilge in each hold was made

British Frozen Meat Cargo Steamer Tairoa

General Information

Service: Refrigerated Freight
Builder: Sir W. G. Armstrong Whitworth & Co., Ltd., Newcastle-on-Tyne, England
Propelling Machinery: The North Eastern Marine Engineering Co., Ltd., Wallsend-on-Tyne, England.
Owner: Shaw Savill and Albion Steamship Co., Ltd., London, England.

Characteristics

Length, overall .....494'-0"
Length, B. P.....477'-0"
Breadth, molded .....62'-9"
Depth, molded, shelter deck.....42'-10"
Depth, molded, upper deck.....34'-4"
Draft, loaded .....28'-10"
Draft, light .....
Height, second to upper deck.....11'-6"
Height, upper to shelter deck..... 8'-6"
Height, shelter to bridge deck..... 8'-0"
Block coefficient .....
Midship section coefficient.....
Longitudinal coefficient .....
Speed, loaded, knots.....12.25
Cruising radius, nautical miles.....
Framing .....Transverse
Class .....Lloyds ✠ 100 A1

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull.....
**Weight Propelling Machinery.....
Deadweight Capacity 11,050
Displacement .....

(In tons of 100 cubic feet)

Gross register 7,983
Net register 5,048

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.
**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez	.....	.....
Panama	.....	.....

Equipment

2 Bower anchors, stockless..... 94 cwts.
1 Bower anchor, stockless..... 81 "
1 Stream anchor, ex-stock..... 25 "
1 Kedge anchor, ex-stock..... 12 "
Cable, 2 9/16" stud chain.....300 fms.
Stream line, 5¼" steel wire.....120 "
Towline, 6" steel wire.....130 "
8" Manila lines (4), each.....100 "

Rudder

Area .....
Dia. Stock .....
C. Press. abaft C. L. pintles.....

Complement

Deck officers 6
Deck crew 32
Engineer officers 9
Engineer crew 34
Purser's and steward's department.... 12
Total officers and crew..... 93
First-class passengers .....None
Second-class passengers.....None
Third-class passengers .....None
Total passengers .....None
Total complement 93

Handling Equipment

	No.	Type	Capacity	Length
Masts	2	Pole	Steel	....
Derrick posts	8	Steel	....	....
Booms	12	Steel	12 Ton	....
Booms	8	Wood	6 Ton	....
Booms	2	Wood	3 Ton	....
Booms	1	Steel	30 Ton	....

Deck Machinery

(Number, Size, Type)

Steering Gear, steam, Wilson Pirrie patent type, telemotor control.
Windlass, steam, two cylinders, 10½" x 14"
Capstans .....
Winches, steam (15).....7" x 12"
Winches, steam (2).....9"x12"
Winches, steam (1).....8"x12"

Life Saving Equipment

	No.	Type	Length
Lifeboats	2	....	26'-0"
Lifeboats	4	....	28'-0"
.....			
.....			

Propelling Machinery

Boilers

Number 4
Type, 2 single ended, 2 double ended, Scotch
Length.....D. E. 21'-6", S. E. 12'-6"
Diameter .....15'-0"
Furnaces 18
Fuel .....Coal
Draft .....Forced
Total heating surface, sq. ft.....15,442
Total grate surface, sq. ft..... 356
Superheat, degrees F. .....
Working pressure, lbs. per sq. in..... 220
Normal fuel consumption:
Per day, tons.....
Per horsepower hour, pounds.....
Normal steam production:
Per hour per pound of fuel.....lbs.
Total per hour.....lbs.

Engines

Number 2
Type....quadruple expansion reciprocating
Size.....22"x31½" x 45" x 65" x 48" stroke
Horsepower, indicated.....5,000

Propellers

Number 2
Type .....4 bladed built-up
Weight .....
Diameter .....
Pitch .....
R. P. M.....
Projected area .....
Developed area .....

Auxiliary Machinery

(Number, Size, Type)

Machinery Space
Main condensers, Uniflux type capable of maintaining a steady vacuum of 26" with barometer at 30" and sea water at 89° F.
Auxiliary condenser (1); Uniflux type, 550 sq. ft. cooling surface, with 18x 10x10 air and 7 inch circulating pumps.
Evaporators (2), 30 ton and 24 ton capacity.
Distiller, capacity 1,000 gal. of drinking water per 24 hours.
Filter .....feed, 4 inch double.
Feed water heater.....25" direct contact
Fuel oil heaters.....
Drain tank .....300 gallons

Pumps
Feed (2); 5¾x24.
Bilge (2); 5½x24.
Sanitary (2); 5x24, double acting.
Independent feed (2); 13½x10x24.
Circulating (2); 14" centrifugal direct-driven.
Ballast (1); 10x12x12, double acting, vert. duplex.
Fresh water (1); 4x4x5, double acting vert. duplex.
General service (2); 9½x7x21, single cyl., double acting vert. feed type.
Forced draft fan 108" diam., driven by 2 enclosed type engines 9 x 6½, with forced lubrication.

Refrigerating Machinery
One duplex machine of Haslam type, carbonic anhydride system; ice melting capacity per 24 hours, 114 tons; 4 electric driven air circulating fans.

Electric Equipment
Generators (2), 20 k.w. at 100 volts, direct driven.
Radio .....1½ k.w. installation
Emergency .....

Holds

No.	Length	Hatches
.....		
.....		
.....		
.....		
.....		
.....		

Capacities

Cargo Space

Compartment	
.....	
.....	
.....	
.....	
.....	
.....	

Refrigerated Space

Compartment	Cu. Ft.
Insulated cargo chambers.....	314,345
.....	
.....	
.....	
.....	
.....	

Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons
.....			
.....			
.....			
.....			
.....			

....cu. ft. per ton;.....gals. per bbl.

Tanks

Compartment	Cu. Ft.	Tons F.W.	Tons S.W.
Total capacity of double bottom tanks (F. W. & S. W.).....		1,514	
After peak (Ballast)...		42	
.....			
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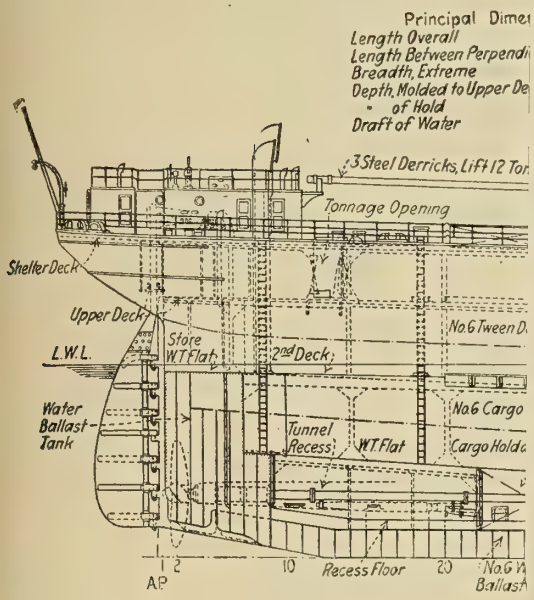
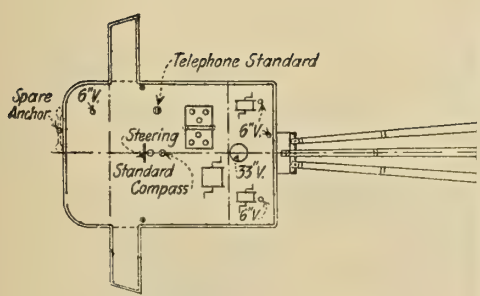
.....			
.....			





TOP OF STEERING GEAR HOUSE.

BRITISH FROZEN MEAT CARGO STEAMER TAIROA

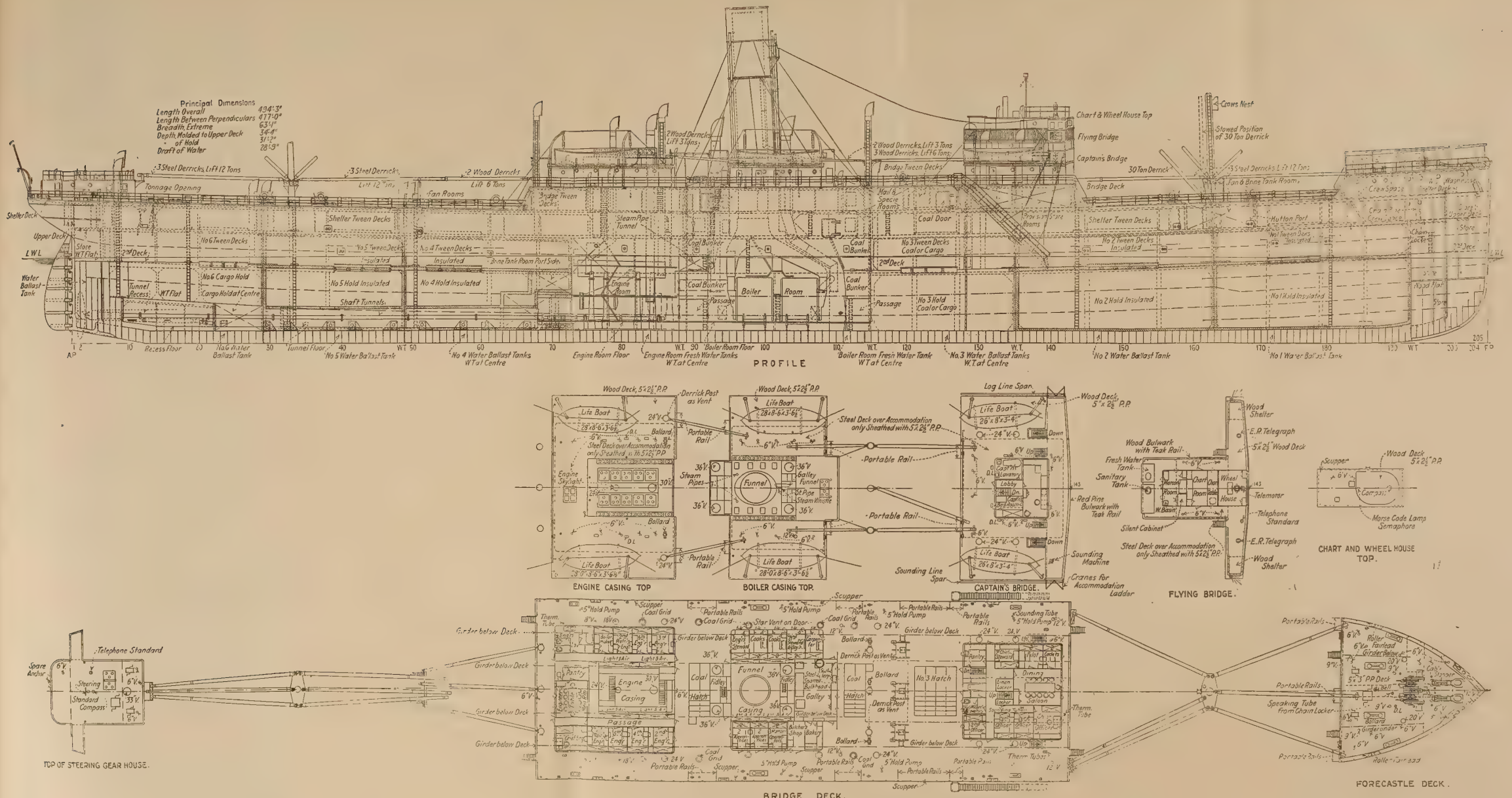
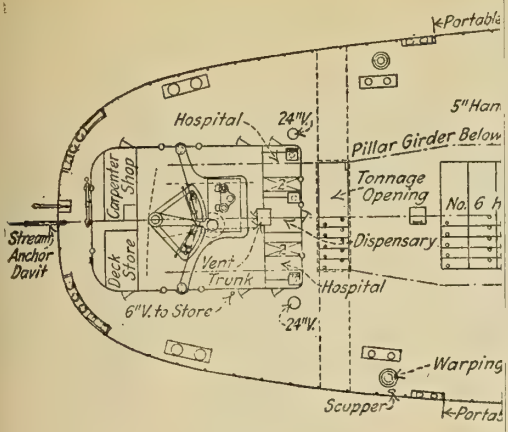
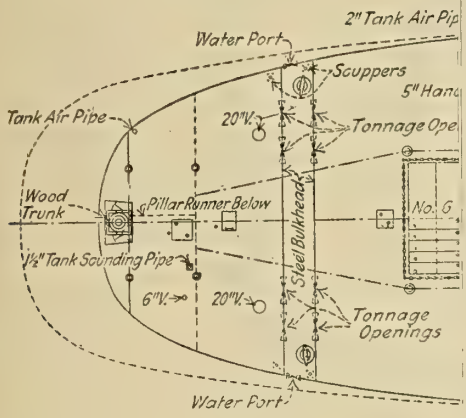
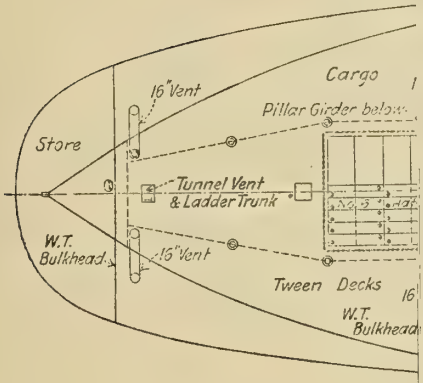
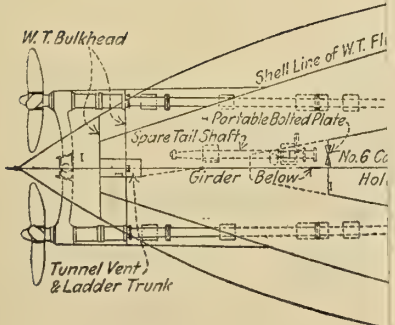


Fig. 1.—Profile and Upper Decks


Portable
Hospital
24"V.
5" Ham
Pillar Girder Below
Carpenter Shop
Deck Store
Vent Trunk
Tonnage Opening
No. 6 h
Stream Anchor Davit
Dispensary
Hospital
6"V. to Store
24"V.
Warping
Scupper
Portab


2" Tank Air Pip
Water Port
Scuppers
5" Hand
Tank Air Pipe
20"V.
Tonnage Ope
Wood Trunk
Pillar Runner Below
No. 6
½" Tank Sounding Pipe
Steel Bulkhead
6"V.
20"V.
Tonnage Openings
Water Port


Cargo
16" Vent
Pillar Girder below
Store
Tunnel Vent & Ladder Trunk
W.T. Bulkhead
15" Vent
Tween Decks
W.T. Bulkhead


W.T. Bulkhead
Shell Line of W.T. Fl
Portable Bolted Plate
Spare Tail Shaft
No. 6 Co
Girder Below
Hol
Tunnel Vent & Ladder Trunk

BRITISH FROZEN MEAT CARGO STEAMER TAIROA

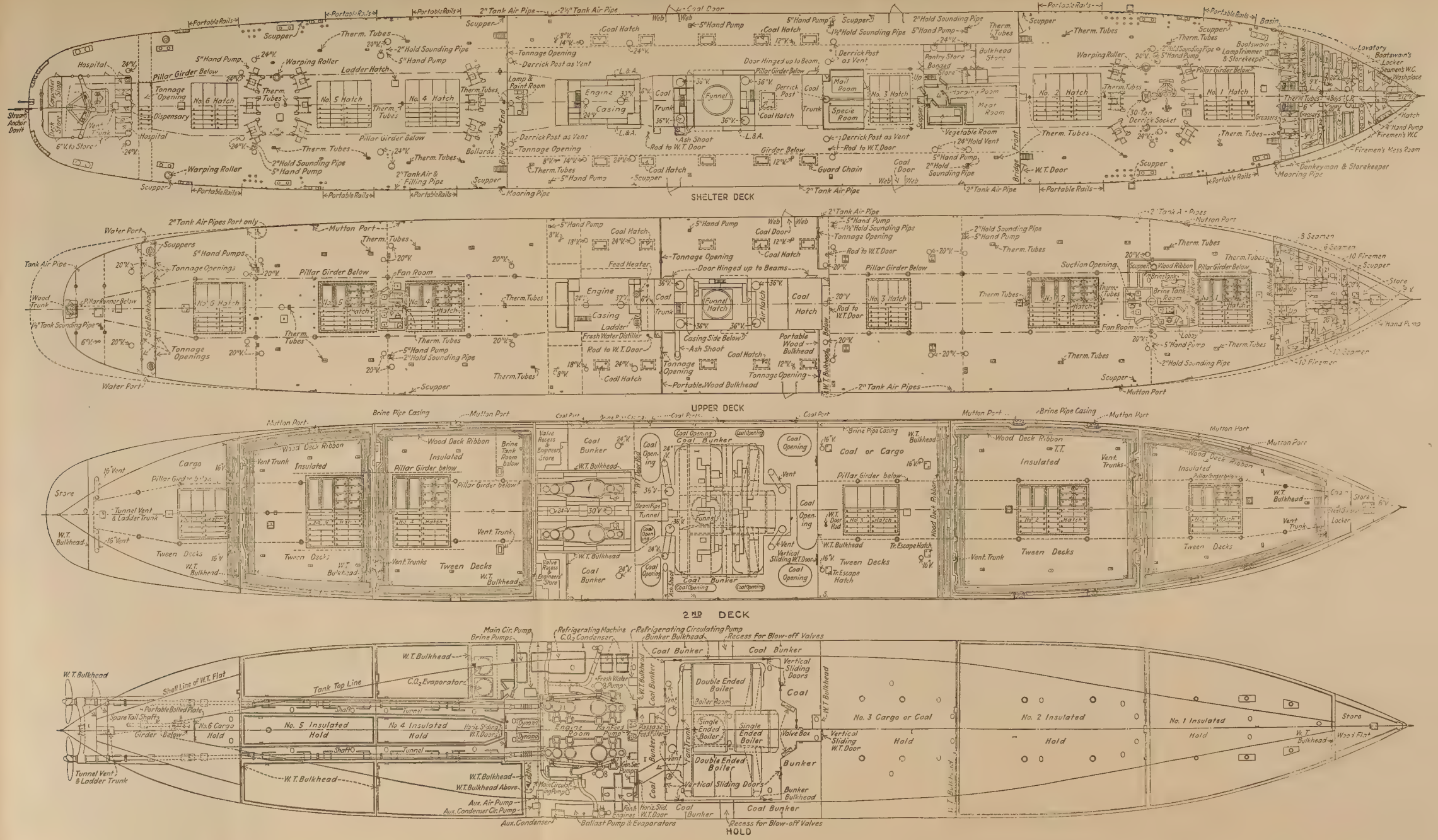


Fig. 2.—Deck Plans

Length Overall	494'-0"
Length on Upper Deck	477'-7" Lloyds Length
Length between Perps on W.L.	477'-0"
Breadth Extreme	63'-1"
Depth Molded (to Upper Deck)	34'-9"
Depth of Hold	31'-3"

Class:-Lloyds +100 A.1. Shelter Deck with Freeboard

SCANTLING NUMERALS

Transverse Number (B+D) = 62.75 + 34.33 + 50 = 97.58
Longitudinal Number L x (B+D) = 477.6 x 97.58 = 46,604
d = 18.96
L/D to Bridge Deck = 9.38 L/D to Shelter Dk. = 11.12

EQUIPMENT NUMERAL

Longitudinal Number	= L x (B+D)	= 46,604
Shelter Tween Decks	477.6 x 8 x .75	= 2865
Bridge " "	180.5 x 8 x .75	= 1083
Forecastle " "	49.93 x 8 x .75	= 300
Engine Casing & House	90.00 x 7.5 x .5	= 150
Boiler " " "	38.00 x 7.5 x .5	= 143
Officers' House	33.00 x 7.5 x .5	= 124
	Equipment Numeral	= 51,269

EQUIPMENT

1 Bower Anchor (Stockless Type) 85¼ Cwts. +10% = 94
1 " " " " 85½ " +10% = 94
1 " " " " 73½ " +10% = 81
1 Stream " (Ex Stock) 25 "
1 Kedge " " " 12 "
300 Fathoms 2⅞" Stud Chain Cable 989 Cwts
120 " Steel Stream Wire 5¼"
130 " " Wire Tow Line- 6"
100 " Manila 8"
100 " " 8"
100 " " 8"
100 " " 8"

FRAMES

Frames in After Peak 7" 3½ x 3½ x .92" angles spaced 28" apart to Shelter Deck.
Main Frames clear of Bridge 9" x 3⅜" x 3½ x .96" Channels spaced 28½" apart to ¾ L Forward from Margin to Shelter Deck.
Main Frames in way of Bridge 9" x 3⅜" x 3½ x .96" Channels spaced 28½" apart from Margin to Shelter & Bridge Decks alternately except for a Distance of ⅓ the Breadth of the Vessel inside Ends of Bridge, where Frames extend from Margin to Bridge Deck on every Frame.
Frames Forward of ¾ L to Collision Bulkhead 10" x 3½ x 3½ x .975 W x .50 F spaced 27" apart from Margin to Shelter & Forecastle Decks.
Frames in fore Peak 9" x 3½ x 3½ x .95" Bulb Angles spaced 26" apart to Forecastle Deck.
Intermediate Frames in Bridge Tween Decks 4" x 4" x .92" Angles.
Main Frames in way of Coal Bunkers increased 2/10"
Reverse Frames in After Peak 3½ x 3½ x .92" to Upper Deck.
Reverse Frames on Main Frames for ¾ L Amidships 3½ x 3½ x .96" to 2nd Deck increased 2/10" in way of Bunkers.
Reverse Frames Forward of ¾ L to Collision Bulkhead 3½ x 3½ x .50" Angles on Frames 176, 177, 179, 181 & 183-6" x 3½ x .55" Angles on Frames 175, 178, 180, 182 & 184 to 192 inclusive all to Upper Deck.
10" x 3½ x 3½ x .975" W. x .50 F. Channel Frames with 3½ x 3½ x .50" Reverse Bar from ¾ L to Forecastle Front.

FORGINGS

Stem Bar 10" x 3⅜"
Stern Post 11" x 3½"
Rudder Stock 13⅜"
Includes 5% above Rules

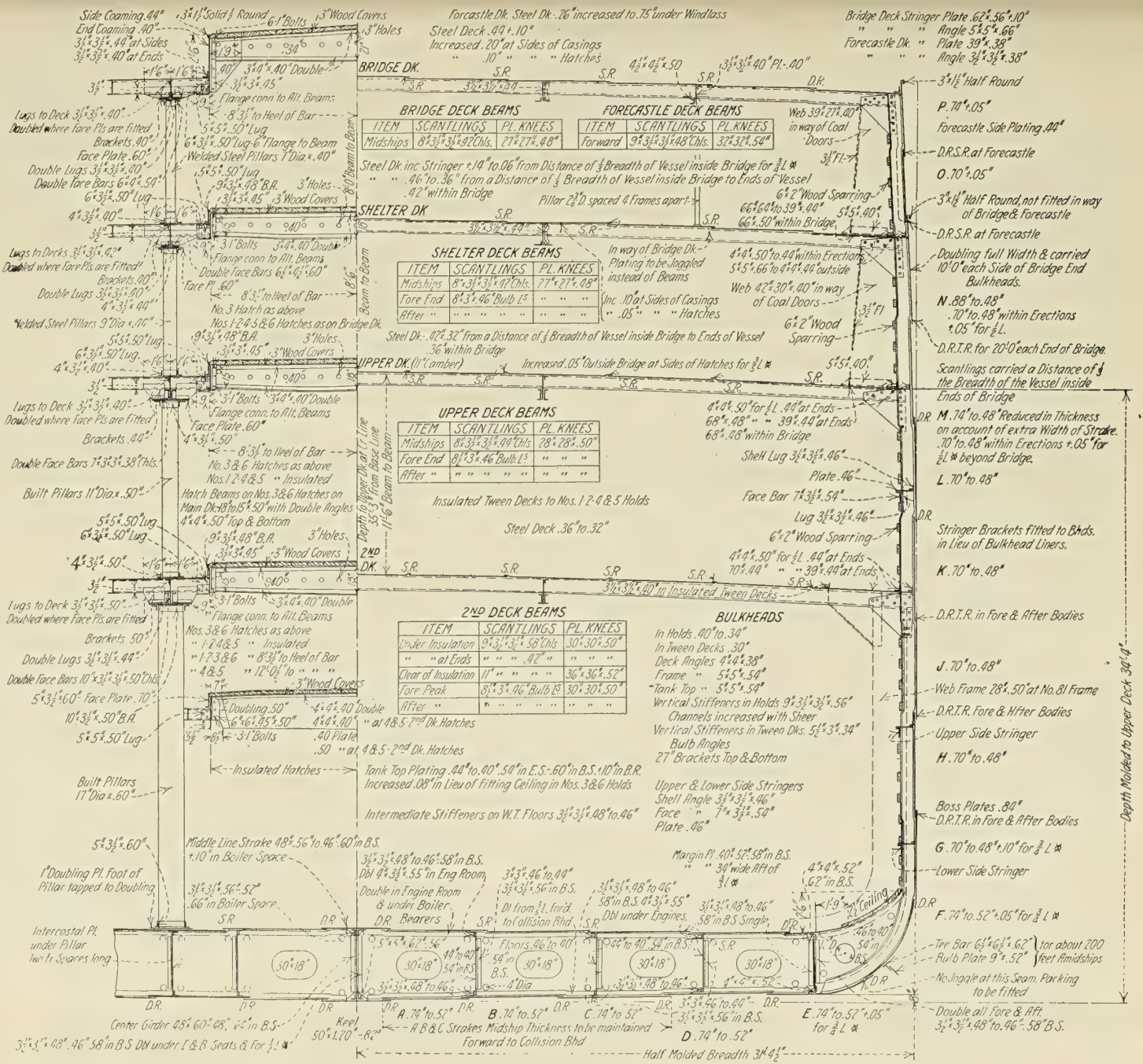


Fig. 3.—Midship Section of S.S. Tairoa

watertight with cement before the side insulation was put in place.

Bulkhead Insulation

The bulkhead at the fore end of No. 1 lower hold and 'tween deck was treated as follows:

Twelve inch grounds 2½ inches thick spaced 26 inches between centers were bolted to the angle lugs or stiffeners and two linings of ¾ inch and 1 inch matching respectively were nailed thereto, the interior space being tightly packed with silicate.

The bulkhead at the after end of No. 1 lower hold had 8 inch by 2½ inch grounds bolted flush with the face of the 11 inch channels spaced 30 inches between centers. Over this, two thicknesses of lining ¾ inch and 1 inch respectively were worked. At the after end of No. 1 'tween decks the grounds were 8 inches by 2½ inches, the remaining details being as for the lower portion of the bulkhead.

The bulkhead at the forward end of No. 2 has grounds 3 inches by 2½ inches thick spaced 30 inches between centers attached to the bulkhead by angle lugs and treated with matching lining and silicate as before described. The bulkhead at the forward end of No. 2 'tween decks was treated similarly to the lower hold but with 4 inch instead of 3 inch grounds.

The bulkhead at the after end of No. 2 lower hold and 'tween deck was treated similarly to the bulkhead at the after end of No. 1 lower hold.

The bulkhead at the forward end of No. 3 lower hold and 'tween deck has grounds 4 inches deep by 2½ inches thick spaced 22 inches between centers and faced with two thicknesses of matching ¾ inch and 1 inch respectively filled with silicate cotton. The insulation in No. 3 hold is protected by galvanized sheet iron No. 16 B. W. G. secured with stout button headed screws spaced close together.

The forward bulkhead of No. 4 hold and 'tween deck has grounds 12 inches by 2½ inches spaced 30 inches between centers, the matching lining and silicate being as before described.

The bulkhead at the aft end of No. 4 hold and 'tween deck has grounds 4 inches deep by 4½ inches thick spaced 30 inches between centers attached to the bulkhead by angle lugs, the matching lining and silicate being as before.

The bulkhead at the forward end of No. 5 hold and 'tween deck has grounds 10 inches deep by 2½ inches thick spaced 30 inches between centers with similar lining and silicate.

The forward bulkhead of No. 5 lower hold is similar to the after bulkhead of No. 2 hold and the forward bulkhead of No. 6 hold similar to the forward bulkhead of No. 3 hold.

In each case the faces of the channel bars, etc., were covered with thickly painted tarred felt.

Stringers

The projecting part of the stringer is covered with ¾ inch hair felt cased in with solid nosing.

Meat Ports

These have heavy pitch pine frame coamings securely fastened to the frames and of suitable depth to allow of a plug of similar description to those described for manhole doors. Chafing plates of 3/16 inch galvanized steel, securely fastened with heavy brass screws, are fitted all round the coaming. Plugs are covered with Fearnought and retained in position with heavy galvanized iron bars bolted to the center plug and secured at the end with thumb screws.

Beam Knees

On the outer edge of each beam knee 7 inch by 2 inch grounds projecting ½ inch beyond the face of the knee are securely bolted with two ⅝ inch bolts. Two thicknesses of lining, ¾ inch and 1 inch, respectively, are run on the face of these and the space between filled with silicate.

Lower Hold Beams, Stanchions, etc.

Grounds 7 inches by 2½ inches projecting ½ inch beyond the lower end of each beam are secured to the beam by ¾ inch bolts spaced 3 feet apart. Under the beams dry hair felt ½ inch thick is placed, one thickness each of ¾ inch and 1 inch matching nailed over all and the space tightly packed with silicate.

All ventilator and ladderway openings are framed out with pitch pine coamings 2½ inches thick and fitted with plugs and fastenings similar to those specified for meat ports. The tube pillars are insulated with ¾ inch of hair felt over which is tightly served 2 inch manila rope. The stanchions and ladders are also served with 2 inch manila rope stopped at frequent intervals.

Side Girders

The side girders have grounds of suitable depth bolted into position so as to give a minimum of 5 inch insulation and ¾ inch of hair felt on the bottom, the whole being covered with two thicknesses of ¾ inch and 1 inch matching lining.

'Tween Deck Beams, Stanchions, etc.

In the 'tween decks the grounds project 1 inch below the beams giving 1 inch of hair felt, except in the brine tank room and 4 feet beyond, where the grounds project 2 inches below the beams giving 2 inches of hair felt.

Ribbon Insulation

The underside of the upper and main decks in Nos. 3 and 6 holds and in the fore peak for one beam space are treated similarly as the overheads in the adjoining insulated holds.

Brackets

Brackets and gusset plates are covered on each cheek with dry hair felt ½ inch thick and clad with wood, through bolted.

Pipes

Where pipes of any description pass through the insulated compartments suitable provision has been made for hanging them, together with plug ports for their examination.

All brine leads, pumps, bilge suctions, sounding and air pipes, etc., throughout the four compartments are efficiently insulated with not less than 8 inches of silicate with grounds and linings to suit their position.

Hatches

The upper and main deck hatches in the three compartments have coamings lined with sawn pitch pine timber bedded on thickly painted tarred felt and bolted through the coamings by ¾ inch bolts sunk beneath the flush and dowelled. The sawn timber has a minimum thickness of 3 inches at the top and increases in thickness to give a bevel of 4 inches at the foot, the lower corners being rounded. The underside of the hatch timber is rabetted out at the inner edge to receive the lower lining and matching in the overhead insulation and the bevelled sides are clad with 3/16 inch galvanized steel bent to shape and secured with heavy brass screws. Heavy galvanized wrought iron pieces are fitted to the lower corners of all insulated hatch coamings. Where wooden coamings project more than 2 inches below the iron coamings flat plate hangers are supplied. Hatch beams are treated in a similar way to hatch coamings.

The insulated hatch covers are constructed as follows:

Sides 2 inches pitch pine; top outer lining 1¼ inches; bottom outer lining 1 inch; inner linings of ¾ inch matching fitted with 3 inch by 6 inch stiffening grounds, one in the center and one in way of each ring bolt; each cover has 6 inches of washed cow hair firmly pressed inside; two ⅞ inch galvanized iron ring bolts with nuts secured through stout plate washers with oval holes in the top washer to admit of the ring lying flat are fitted to each hatch.

On each side of the 'tween decks and hold insulation, meat battens 2 inches by 1¾ inches with the edges chamfered and spaced 9 inches apart are secured from the underside of the deck in line with the limber hatches.

Brine Service, etc.

Delivery and return brine leads serving the compartments are insulated with a minimum of 8 inches of silicate cotton, cased in with two thicknesses of 1 inch matching on grounds of suitable size, the whole being put together in sections which correspond to the lengths of pipes. The casings which pass through general cargo or bunker spaces are covered on the outside with galvanized sheet iron No. 16 B.W.G. carried up to the deck, fitted dust tight and neatly secured with brass screws.

Brine Service Pumps, etc.

The brine pumps, brine return tanks, brine distributing boxes and service pipes and also the brine mains are insulated in a suitable manner. The brine grids on the sides and bulkheads of all chambers, holds, 'tween decks and tunnels are substantially secured, this being effected by wood chocks suitably spaced and secured with coach screws into the grounds of the insulation, the heads of these being again covered with hard wood strips. The brine pipes in the bunkers in way of Nos. 4 and 5 holds are protected at the sides with closed pitch heavy wood chocks. Where brine pipes pass through the deck the 6 inch by 3 inch angle iron coaming is riveted and made watertight and the intersections between the brine pipes securely filled in and grouted flush to the top of the angle bar with Wailes Dove bitumastic.

Ship's Provision Chambers

In addition to the spaces previously described the ship's provision chamber and vegetable rooms, etc., are located in the bridge space. The bottom of each compartment is covered with bitumastic cement ¼ inch thick. The floor of ¾ inch and 1¼ inch match linings is laid on bearers 3 inches wide by 2 inches thick spaced 18 inches between centers, the space between being filled with silicate.

The floor is covered all over and 18 inches up the sides of all compartments with 8 pound lead, bedded on Stockholm tar all joined, carefully soldered and fastened with copper tacks close up along the upper edges of the flashing. The sides have grounds 3 inches by 12 inches set up on edge to the underside of the deck overhead and covered with two thicknesses of lining ¾ inch and 1 inch thick, the space between being closely packed with silicate.

The ceiling has grounds of suitable depth bolted to the beams, the lower edges of which project 12 inches below the deck plates and are faced with two thicknesses of ¾ inch and 1 inch, respectively, the intermediate space being filled with silicate.

The floor is covered with 1¼ inch tongued and grooved matching on 1½ inch bearers in handy sections for lifting out and cleaning purposes. The underside of the shelter deck in way of the meat chambers, etc., but extending at least 4 feet more in each direction than the compartments above, is treated similarly to the ceiling above mentioned and is covered with galvanized sheet iron of No. 16 B.W.G. secured by brass button headed screws.

Hinged plug doors are fitted for access to the chambers. All insulated doors are fitted with Taylor's galvanized iron hinges and door fasteners of suitable hasps and staples for locking purposes.

Galvanized iron racks, shelves and meat hooks in both rooms are provided.

The bulkhead dividing the vegetable from the meat room is framed with 6 inch by 2 inch grounds spaced 2 feet apart and faced on both sides with two thicknesses of ¾ inch and 1 inch matching, the intervening space being filled with silicate.

The underside of insulation in way of limbers, etc., was given three coats of paint.

All woodwork, except floors, received three coats of varnish.

Ventilating Ducts

These are suitably insulated with the necessary plugs similar in every detail to those fitted in meat ports and secured in place with similar arrangements.

All the wood used for grounds throughout the whole of the insulation, as well as lower linings at the turn of the bilge as high as the first stringer, were first treated with a zinc chloride or Burnettizing process.

Acetylene for Ship's Lighting

THE Marine Department of the Board of Trade has just issued the following instructions to surveyors in respect of acetylene for lighting purposes:

1. The generator should comply with the regulations as to acetylene generators issued by the British Acetylene and Welding Association.

2. No copper, compo, or flexible piping should be used for conveying the gas from the generator to the burners. Preferably the pipes should be of solid drawn steel or brass, the former being tinned to prevent corrosion, but they should not be copper plated. After the pipes have been installed on board, they should be suitably tested, and in no circumstances should a naked light be used.

3. Each generator should be furnished with an automatic cock or other similar contrivance, so that the gas will be automatically shut off the main distributing pipes when the pressure in the generator is practically exhausted.

4. A distribution box should be fitted near the generator, to which the distribution pipes conveying the gas to the various burners should each be connected by means of a shut-off cock, so that when the pressure of gas in the generator is exhausted the entire supply of acetylene can be shut off from the burners. A conspicuous notice should be affixed near the distribution box to the effect that:

"When the pressure of gas in the generator is nearly exhausted, or the generator is out of use, the various cocks in the distribution box should be shut, and should not be opened again to any compartment until an assurance is given that the burners in that compartment are shut."

5. A properly constructed metal storage container fitted with a jointed cover so that it can be hermetically sealed, should be provided near the generator for the storage of the carbide of calcium. A conspicuous notice should be affixed near the generator and storage container to the effect that "No naked light is allowed near the generator or the carbide container."

6. It is understood that the carbide of calcium is usually delivered on board in the ordinary commercial drums weighing 50 or 100 kilograms. For convenience of handling and safety, it is strongly recommended that smaller packages be employed for this purpose. No serious objection need, however, be raised at present to the use of the larger drums provided a suitable eye-bolt is fitted to the engine room skylight and blocks and tackle furnished. The owners should issue a warning to the engine man that immediately the carbide of calcium is delivered, or at any rate before the vessel proceeds to sea, the carbide should be removed from the drum in which it is delivered into the storage container, and further, that the blocks and tackle must be employed to lower the drums into the engine room. Neglect to adopt this simple precaution has resulted in one instance in loss of life and in serious danger to the entire crew.

7. Carbide drums should not be opened by the use of a hammer and chisel, but a suitable carbide drum opener should be used. In handling carbide and charging the generator, care must be taken to avoid the creation of sparks.

Are You a Marine Engineer, Edison Standard?

Questions That Mr. Edison Might Ask His Engineers If He Were in the Shipping Business

By "Old Scotch"

THE publication of one hundred test questions for applicants for positions in Thomas A. Edison's industrial enterprises aroused a wave of interest throughout the country. They are said to have floored honor men who had graduated from some of our leading colleges and universities and in general they kicked up a storm of adverse comment, because of their alleged unfairness. These questions to those familiar with them, and most readers of the daily press are, combined matters of history, general information and technical subjects and as a whole were a very fair test of a man's knowledge of a general character. To men of fair education, some years of experience and a good memory they were not very difficult: to young college or high school graduates, without much experience they appeared most difficult, and it is not at all strange that many such could not pass the test.

Let us suppose that Mr. Edison was of as much importance in the shipping world as he is in the electrical, and that he wished to employ some marine engineers. He would probably then subject the applicants to such a test as given in the following questions.

Many readers of his test questions gave themselves a conscientious self-examination, and assigned appropriate marks for each answer they could, offhand, give to the questions. So, my brother marine engineers, here is a chance for you to do likewise, and I hope some of you will send in the standing which you will assign to yourself in answering the following:

1. Who built the first triple-expansion engine in this country?
2. About what year was it installed and in what vessel?
3. Were marine boilers ever made of other material than iron or steel?
4. If so, what material or materials was used?
5. Name one large American passenger vessel which used a compound oscillating engine within the past thirty-five years.
6. What is the largest American passenger vessel?
7. What is the largest American freight vessel?
8. What is the largest horsepower used in any American-built vessel?
9. What is the largest side-wheel steamer now in use in this country?
10. Has any steamer ever been built in this country which used neither screw nor paddle wheels for propulsion?
11. If so, what method of propulsion was adopted?
12. Who invented the screw propeller?
13. What vessel was known while under construction as the "dynamite gunboat"?
14. What is the largest tugboat in the United States?
15. What is a hydrokineter and for what purpose is it used?
16. Why is bituminous coal used on steamships instead of anthracite?
17. What is cavitation and how is it caused?
18. How is the horsepower of a reduction geared turbine determined?
19. How is the horsepower of a Diesel engine ascertained?
20. What is CO_2?
21. What is the ideal percentage of CO_2 for efficient combustion?
22. What is "slip" and how is it determined?
23. What is forced lubrication, as applied to marine engines?
24. Does a triple expansion engine always have three cylinders?
25. How many barrels of ordinary fuel oil are equivalent in steaming value to a ton of ordinary bituminous coal?
26. What are the purposes of a deep tank on a freight vessel?
27. What is the mechanical equivalent of a heat unit?
28. What other material than wrought iron or wrought steel is sometimes used for anchor chains?
29. Who produced the first successful marine steam turbine?
30. How many cubic feet are there to a ton of bituminous coal?
31. What is the temperature of steam corresponding to a gage pressure of 200 pounds per square inch?
32. What is the generally adopted diameter of condenser tubes?
33. What type of condenser is almost universally used on Great Lakes steamers?
34. What is meant by a triple effect evaporator?
35. How would you determine whether or not distilled water contained salt?
36. What is meant by 28 inches of vacuum?
37. What is meant by 2½ inches of air pressure in a fireroom?
38. What is a single acting engine?
39. What is an average temperature at the bottom of the smoke stack?
40. Were geared marine engines ever used before 1900?
41. If so, wherein did they very materially differ from present types of geared turbines?
42. What was the name of the first steam vessel which crossed the Atlantic?
43. What firm, now in existence, built the original *Monitor?*
44. Name an American educational institution entirely devoted to naval architecture and marine engineering.
45. Who is the present head of the Steamboat Inspection Service and what is his official title?
46. Name three well known manufacturers of marine pumps.
47. What is a pneumercator, and what is its purpose?
48. How many members are there to the Shipping Board?
49. What is a red ink license, and why are they so called?
50. What department of the Government has jurisdiction over the Light House Service?
51. How much toll will have to be paid by a 5,000 net tonnage freighter going through the Panama Canal, loaded?
52. How are the living quarters on a motorship heated?
53. Is there any patent on a Diesel engine?
54. What is the origin of the term "starboard"?
55. For what is a clinometer used on shipboard?
56. State Simpson's rule.
57. What is a planimeter?
58. For what length of time is a marine engineer's license good?
59. What is the "deadweight" tonnage of a ship?
60. What materials should be used for suction pipes in bilges?

61. What is the approximate area of smoke stack in proportion to the grate surface?
62. Why should the use of cylinder oil be restricted to a minimum?
63. From what is the term "monkey" wrench derived?
64. How many cubic inches are there in a gallon of oil?
65. Why should not alternating current be used for the propulsion motors in an electrically driven ship?
66. What is the average percentage of electrical loss between generator and motor in an electrically driven ship?
67. What is the proper proportions of glycerine and water in a hydraulic telemotor steering gear system? Why is glycerine used?
68. What is a fair steam consumption per horsepower for a turbine reduction main drive?
69. What material is mostly used to line stern bearings?
70. Name four of the principal American manufacturers of turbine reduction marine engines.
71. Who was the inventor of the most generally used bilge suction strainer?
72. What is the principle on which an ordinary pyrometer works?
73. What is the correct position to place a draft gage in a forced draft system?
74. What should be the maximum chlorine contents of feed water for watertube boilers?
75. The same for Scotch boilers?
76. How should a steam deck winch be safeguarded in freezing weather?
77. Name three principal causes of excessive sparking of brushes on a marine generator?
78. If three water gage glasses on a marine boiler should break within an hour, what would you think caused it?
79. Why is zinc used in a boiler?
80. When should zinc plates be used around the stern post and rudder post?
81. Why are load lines fixed for sea-going vessels?
82. What elements should be considered in certifying to the amount of fuel oil received, if the contract is by the barrel, and payments are to be made by the ton?
83. What causes spontaneous combustion in a ship's bunkers?
84. What materials are generally used to filter feed water for marine boilers?
85. What precautions should be taken before sending a man into a tank which has contained fuel oil?
86. What superiority has a Diesel engine over a steam engine for marine propulsion?
87. Wherein does a steam siren differ from an ordinary whistle?
88. What is cop waste?
89. What treatment is best for bad steam burns?
90. What is meant by a "feathering" paddle wheel?
91. How are steam gages tested for accuracy?
92. What is the difference between a tube and a pipe?
93. What is a dynamometer?
94. Will a gasoline engine work in a motor boat without a clutch?
95. For what purpose is a devil's claw used on board ship?
96. Who is the president of the American Society of Naval Architects and Marine Engineers?
97. Name three prominent marine papers published in the United States.
98. What is the leading treatise on marine engineering published in America?
99. What is a Naperian logarithm?
100. Give ten good reasons why marine engineers have to know more than locomotive engineers. Name one hundred if you like.

Now, after you have read over the foregoing I can hear you say "What's the matter with this old guy, anyhow, to ask such foolish questions?" or perhaps it will be "Any fool can ask questions which ten wise men cannot answer." All right, I'll admit it, and perhaps I cannot answer them all myself, but just the same they will give you a very good test, as there are no catch questions among them. If you can, with a clear conscience, give yourself a rating of 70 percent, "I'll tell the world" that you are an up-to-date marine engineer, and will recommend you to Edison for a job—that is, if he goes into the steamship business.

Reorganization of the Shipping Board

(*Concluded from page* 580)

When the new administration took command at the Shipping Board there were three or four boats out on the bare boat charter plan. However, the disposition under the old regime was to proceed cautiously in this direction on the theory that the bare boat charter plan, in its present shape, does not offer a solution for the problems of the Shipping Board. Nevertheless, it is conceded by the minor officials in the Shipping Board who have been closest to the operation of the bare boat charter system that the prevailing system has revealed grave defects or shortcomings.

Bare Boat Charter Plan

It is admitted, for example, that there is some justification for the criticism by practical shipping men who have charged that the Shipping Board has, under its allocation program, indulged in a wasteful duplication of service to certain ports and that trade routes have been established which cannot be operated save at a loss. The retort at the division of operations has been that the Shipping Board has striven consistently to eliminate the services which have proved to be unprofitable.

That the Shipping Board's vessels have been unnecessarily competing among themselves is due, so the officials contend, to the agreement that became effective March 1, 1920, which permitted the managing agents considerable latitude in the handling of ships. The consequence of this granting of a free hand in operation was that there was concentration in the quarters where cargo appeared to be available and the outcome was the overtonnaging of certain berths. When the new management took hold, the division of operations was in the midst of an effort to correct this operation at cross purposes by eliminating a certain proportion of the managing agents and so combining services as to bring about cooperation instead of competition. This snuggling up process has already been inaugurated in the South Atlantic and the revision of North Atlantic schedules is under way. The whole tendency in the division of operations in recent months has been to cut down the number of trade routes rather than to increase the total, albeit a few additions have been made. The policy of gradual elimination has been based on the belief that the war created a heavy movement of tonnage on trade routes which could not be permanent.

It is a foregone conclusion that the reorganized Board, with its determination to take the Shipping Board out of the shipping business as promptly as may be, will conform to the policy heretofore in force which contemplates the winding up of the shipbuilding program not later than April, 1922. There has, however, been suggestion in Congress that the Shipping Board ought to shut down tight on its building operations in all yards for an interval of say six or eight months. The loss that would be entailed by such interruption, not to mention the injustice to shipbuilders, has prevented the proposal receiving serious consideration. Whatever experimentation may be necessary, ere the reorganized Board "finds itself" the expressed determination of its chairman is to justify the belief of President Harding that it is possible to place a permanent American merchant marine on a paying basis.

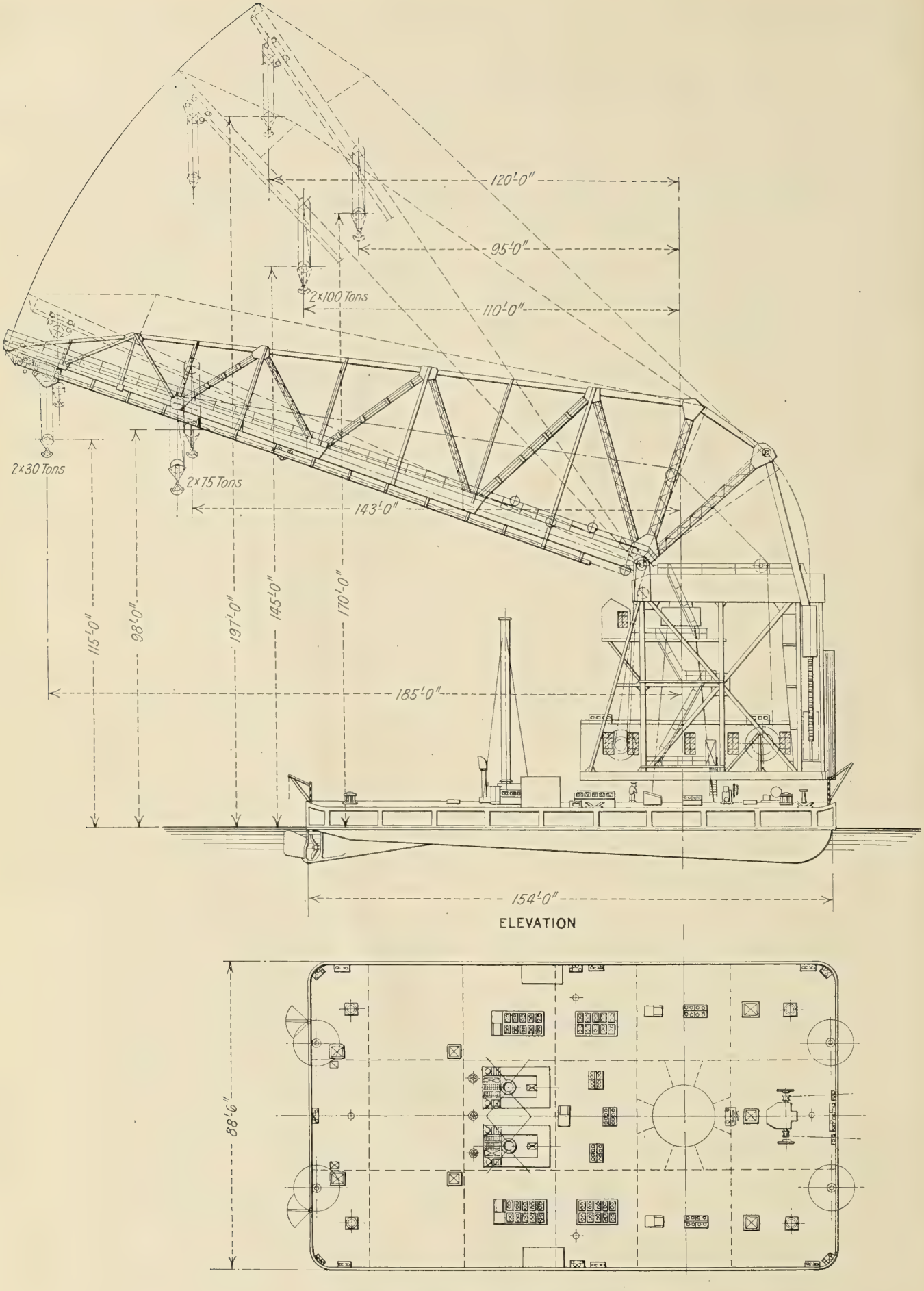


Fig. 1.—200-Ton Floating Crane Mammouth

Derricking Jib Type Floating Crane Mammouth

200-Ton Floating Crane Acquired by the Mersey Docks and Harbor Board for Service in the Port of Liverpool

IN order to meet the increased demand in the port of Liverpool for a high capacity crane for dealing with heavy loads, the Mersey Docks and Harbor Board has acquired a floating crane capable of handling loads up to 200 tons. This crane, named the *Mammoth,* is of the derricking jib type and was built by the Werf Gusto, Firma A. F. Smulders, Schiedam, Holland. The arrangement is such as to permit the handling of heavy loads over the gates of large graving docks, an asset of great value to the ship repair business.

Pontoon and Crane Structure

The crane structure is mounted on a self-propelled pontoon, 154 feet in length and 88 feet 6 inches beam. The crane is carried on a tower about 66 feet high, built in the form of a truncated cone and strongly secured to the deck, sides and bottom of the pontoon.

There are two principal parts to the crane, these being the framework and the jib. The framework may be divided into the upper platform, which rests on the top bearing, a lower platform in which the center rollers of the tower are placed and the connecting structure between. The jib is connected to the framework by two pins at the front of the upper platform and by two links to a movable counterweight located between the platforms at the back. Vertical guides are provided and the counterweight is operated between these by vertical worm shafts, the raising and lowering of the jib being accomplished in this manner. Behind the crane framework and cabin is another counterweight for further balancing the crane.

Capacity

The scope of action and lifting capacities of the crane are shown in the following table:

Load, Tons	Radius, Feet	Clear Overside and Overstem Distance, Feet	Height of Blocks Above Water, Feet	Speed of Lift, Feet Per Minute	Remarks
200	110 Max.	65¾ Max.	145	3½	Loads handled by blocks fixed on crane jib.
	95 Min.	50¾ Min.	170	3½	
150 and less to 60	143 Max.	98¾ Max	98	3½	
	95 Min.	50¾ Min.	170	3½	
60 and less	185 Max.	140¾ Max.	115	16½	Loads can be handled by trolleys along the full length of the jib, at a speed of 12 feet per minute to a minimum radius of about 30 feet.
	120 Min.	75¾ Min.	197	16½	

The crane is designed so that the loads can be revolved through a complete circle without the adding or removing of any special counterweight.

Operator's Cabin

A cabin is built at the top of the framework just below the jib hinge pins and from this point the various movements of the crane are controlled. Only one man is required in the control cabin even when handling the heaviest loads and he has a clear view of the load and the deck of the pontoon, being thus able to observe all movements of the weight he is dealing with.

The simplicity in handling is accomplished by connecting up the electrical installation in accordance with the Ward-Leonard system. This system enables any load to be hoisted or lowered at extremely low speeds, a feature of great importance when handling heavy weights, erecting, etc., and also permits any weight to be moved at varying speeds without any change being made in the mechanical transmission. Other advantages of the Ward-Leonard system are that only weak currents are controlled, thus reducing the wear and tear of contacts to a minimum and practically eliminating loss of energy. The starting of the motors is accomplished without placing any undue stresses on the crane structure or the transmission gear and owing to the small number of controllers, switches, etc., the maintenance charges are low.

Fig. 2.—Floating Crane Mammouth in Action

Winch Room

A winch room about 65 feet by 23 feet is located on the lower platform and in this room is located the machinery for operating the crane.

All the movements are effected by electric motors of which there are ten in all. The power is transmitted from the motors by worm gearing and gear wheels and electrical brakes are fitted to all motor shafts.

Generating Plant

The current for operating the electric motors is supplied by dynamos driven by one of the triple expansion steam propelling engines which, with their switchboards, are located below decks in the pontoon.

Electric cables convey the current from the dynamos to the interior of crane tower. The cables are connected to slip rings on the outside of the upper end of the tower and from these slip rings the current is collected by brushes and dis-

tributed to the various motors in the winch room and to the control cabin.

Wherever possible, safety devices have been fitted such as switches for limiting the working range of each movement and the speed of trolleys, emergency switches, electrical brakes and automatic cut outs for guarding against too heavy currents.

Propelling Machinery

Twin screws are provided to propel the pontoon, the engines being of the triple expansion marine type working at a steam pressure of 150 pounds per square inch.

One of the engines is arranged so that it may be uncoupled from the propeller shaft and used to drive the generating plant used for supplying current for operating the crane.

In a trial trip conducted on the River Meuse an average speed of 4.85 miles per hour was attained.

Boilers

Steam is generated in two boilers designed for a working pressure of 147 pounds per square inch and located between the engine rooms.

Electric Lighting

A very extensive electric light installation for the pontoon and crane is provided, the dynamo and switchboard for this purpose being located in one of the engine rooms.

Deck Machinery and Fittings

The deck machinery is very complete and includes a windlass, four capstans operated by engines located below the deck of the pontoon, steam steering gear, bollards, etc.

Accommodations

Only three men are required for operating the crane, these being an engine-driver, deck hand and crane-driver.

Cabins, galley and lavatory for the crew are provided.

Provision for a lamp room, coal bunker, storeroom, water tank, etc., is also made.

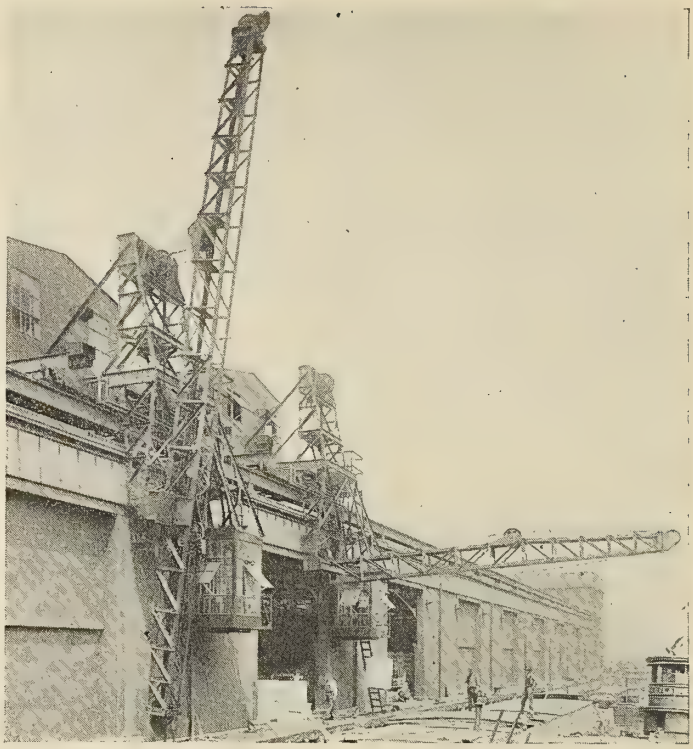
The crane was towed from Schiedam to Liverpool without the jib being dismantled.

Time and Labor Saved in Handling Freight at New York Barge Terminal by Installation of Modern Crane Equipment

By Henry Cunningham, Jr.

UNTIL recently freight handling methods on Pier 6, East River, New York, the terminal of the New York State Barge Canal, were rather antiquated, consisting principally of a whip boom, block and tackle and a horse for motive power. The operation of raising the load from the hold of a barge consisted in walking the horse, which was at the end of the lift line, along a drive until the load reached a sufficient height, when the whip boom was swung around by hand and the load deposited on the apron of the pier. From here it was moved by hand under the pier shed. The inefficiency of this system, and the delays caused by it, made necessary the installation of modern equipment.

The new installation includes two Shaw wharf cranes, manufactured by Manning, Maxwell and Moore, Inc., New York City. These cranes are of the overhead type, traveling on two tracks, one carried over the front row of the building columns and the other 10 feet back over the roof of the pier. Each boom, which has an outboard reach of 32 feet 6 inches and an inboard reach of 10 feet, is pivoted to the traveling frame. The capacity of each crane is 3,000 pounds with the boom horizontal or at any angle up to 45 degrees and with the trolley in any position on the boom.



3,000-Pound Shaw Wharf Cranes Installed at Pier 6, East River, New York

As indicated, the cranes travel on tracks above the pier shed roof, and therefore do not obstruct the apron of the pier. While traveling, the boom is nearly vertical, in which position ample clearance is allowed between the pier shed and the ship's rigging. When the location for action is reached the boom of the crane is lowered, the outboard end being over the hatch of the vessel and the inboard reaching inside the pier shed. Packages from the barge or vessel may be hoisted from the hold and deposited inside the pier shed, thus relieving congestion due to hand distribution. By utilizing simultaneously the hook hoist and trolley movements the load may be carried in a diagonal line from loading to unloading points.

The cranes are equipped with type "Z" Shaw motors, operating on 220-volt direct current. The hook hoists and rack motors are of 18 horsepower, compound wound, and the boom and travel motors 8 horsepower series wound. All motors are equipped with a series wound solenoid operated band brake. The controllers are of the drum type with vertical handles.

The hook hoist and rack have a speed of 125 feet per minute with the full load, and 200 feet per minute with no load. The boom may be hoisted from the horizontal to the vertical position in one minute. The traveling speed is 100 feet per minute. The hook hoist, trolley rack and boom hoist machinery are located on the crane frame, well to the rear, where they act as a counterweight, thus giving stability to the crane. The operator's cage is suspended from the crane frame at one side of the boom at a sufficient height to give the operator a clear view of the load.

With the former method of freight handling at Pier 6 it took eight men with the whip boom, block and tackle and horse equipment four days to unload 175 tons of freight. With one crane and two men in the hold of the barge, 175 tons of miscellaneous freight have been unloaded in an eight-hour day with the new equipment. As this record was made while the cranes were new and the operators somewhat slow in having the freight in the slings ready to be hoisted, the style of operations still offers an opportunity for further savings in time of loading and unloading barges.

Electrically Propelled Freighter Biyo Maru

Japan's First Merchant Vessel Equipped with Electric Drive an 8800 Deadweight Ton Freighter

By C. Ano*

TOYO KISEN KAISHA, under the presidency of Mr. Soichiro Asano, one of the most progressive and energetic business men of the Far East, has always been keen on improving the economy of their ships along highly technical lines. They have been the first steamship owners in that country to own and operate an ocean going turbine steamer and also a geared turbine steamer (*Tenyo Maru* in 1908 and *Anyo Maru* in 1912, respectively) and probably the first steamship owners in the world to make practical use of mineral oil for the fuel of ocean going steamers. Now they are to have the honor of being the owners of the first electrically propelled merchant vessel in Japan.

Principal Dimensions

Length between perpendiculars	400 feet 0 inches
Breadth molded	53 feet 0 inches
Depth molded	32 feet 0 inches
Tween deck height	10 feet 0 inches
Gross tonnage	5,479 tons
Load draft	25 feet 9 inches
Deadweight carrying capacity	8,800 tons
Designed speed at sea	11 knots

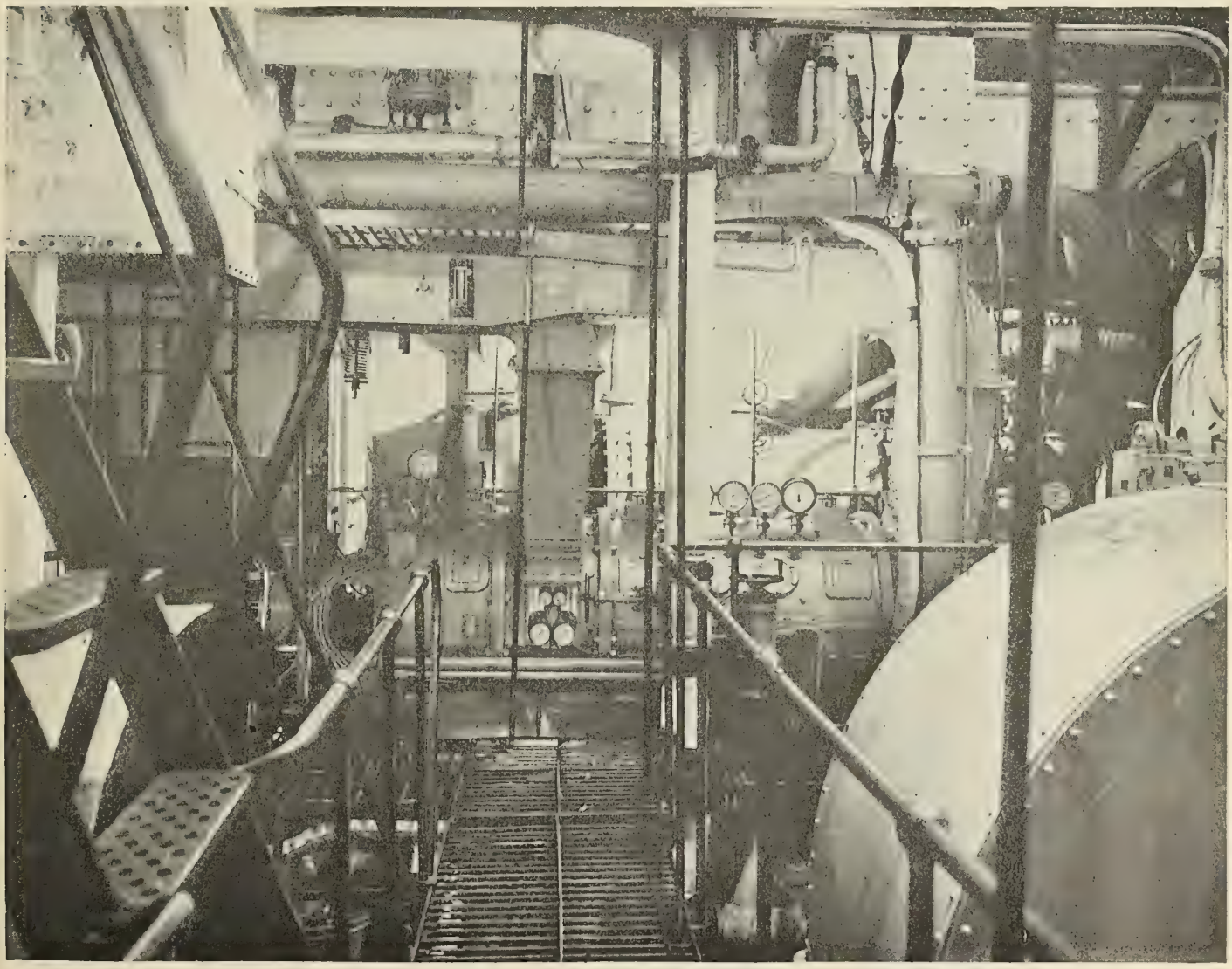
*Director and chief draftsman, Asano Shipbuilding Company.

Propelling Machinery

The propelling machinery is located amidships and its main parts consist of two sets of Ljungstrom turbines, each driving two electric generators and two induction motors which drive the propeller shaft through a helical toothed single reduction gear, all manufactured by the Svenska Turbinfabriks Aktibolaget Ljungstrom, Finspong, Sweden.

The turbines are the radial flow double rotation type and are designed to work with steam at a pressure of 225 pounds per square inch and superheated up to 650 degrees F. at the inlet valve and to discharge into a vacuum of 29 inches. Each turbine has two sets of blading turning in opposite directions coupled to two three phase alternating current generators of the revolving field and self exciting type.

Each generator is designed to run at 3,600 revolutions per minute and to give a three phase alternating current of 1,000 volts at 60 cycles. Each turbine, with the generator coupled



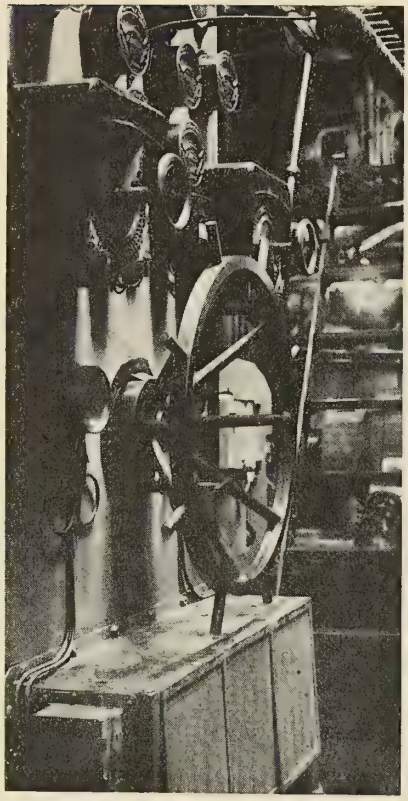
Engine Room of S. S. Biyo Maru, Showing Starboard Turbine and Generator

on, is mounted on a surface condenser, which rests on a strong steel plate girder foundation.

Each of the induction motors is to develop 1,360 horsepower with the current of 1,000 volts and 60 cycles and at the normal speed of 600 revolutions per minute.

Reduction Gearing

The reduction gearing consists of a large helical toothed spur wheel and two pinions, each of which is coupled to one of the induction motors. The ratio of reduction is about 7.5, the normal rate of revolution of the propeller shaft being 80 per minute which corresponds to a speed of about 11 knots when the ship is fully loaded.



Maneuvering Gear

The main maneuvering gear is in a rectangular pillar stand containing switches, electro meters and the liquid type resistances, and is worked with a large hand wheel in the front.

Electrically Driven Auxiliaries

The auxiliary machinery, used in conjunction with the main machinery, is electrically driven, each unit being fitted with a separate induction motor taking current from the main generators. It consists of:

2 sets of air pumps, fitted with cylindrical tanks and working on the kinetic system.
2 sets of circulating pumps, of centrifugal type.
2 sets of main feed pumps, of centrifugal type.

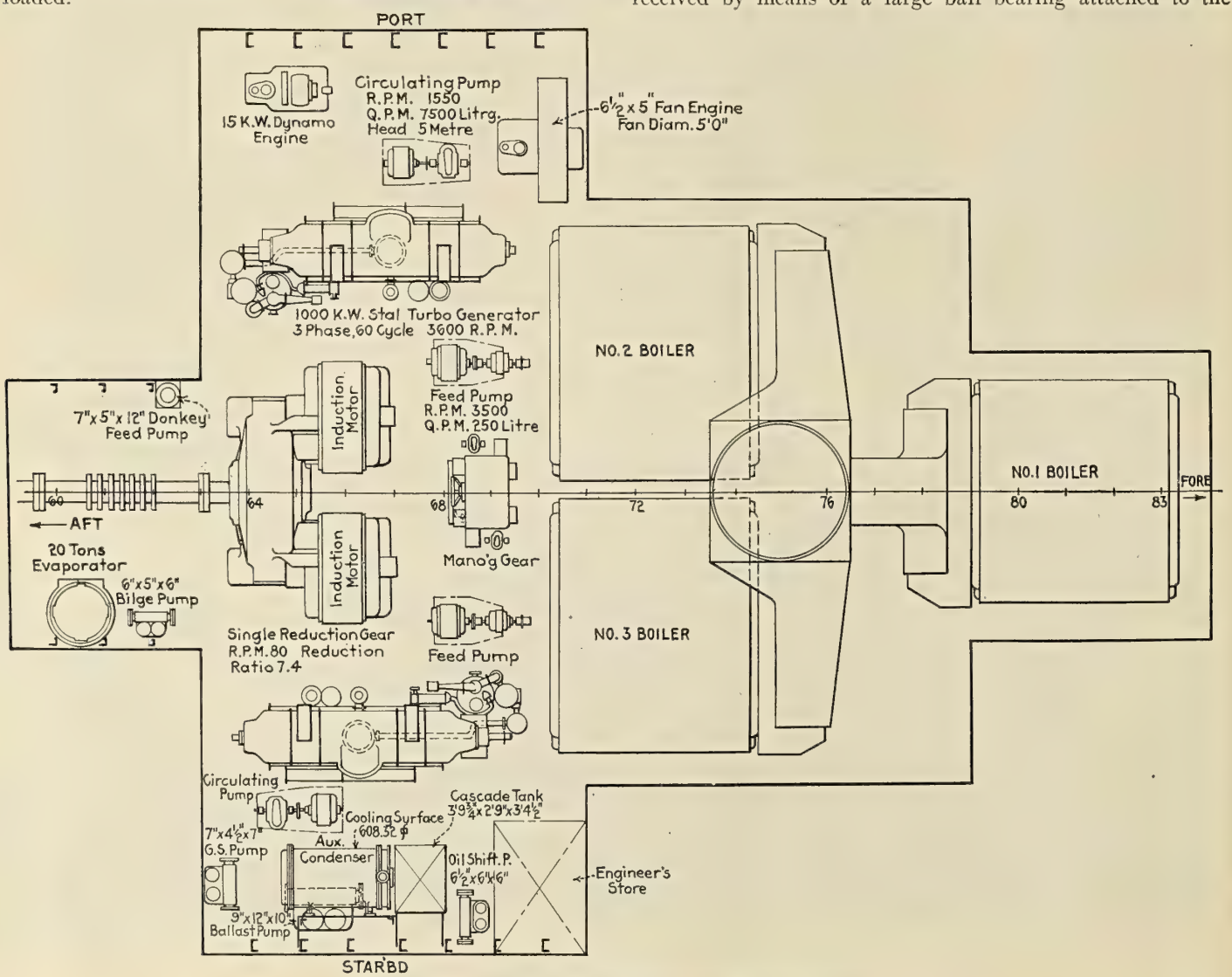
Other auxiliary machinery in the engine and boiler rooms are steam driven and include the following:

Donkey feed pump: one simplex double acting	7x5x12
General service pump: one duplex double acting	7x4½x7
Ballast pump: one duplex double acting	9x12x10
Bilge pump: one duplex double acting	6x5x6
Fuel oil shift pump: one duplex double acting	6½x6x6
Fan engine for harbor use	6½x5

Besides these, there is an ash hoisting engine, evaporator, auxiliary condenser, feed water heater, feed water filter, two fuel oil pumps and a small fuel oil gravity tank.

Propeller

The propeller is 17 feet 9 inches in diameter with blades set at a pitch of 16 feet 1½ inches. The blades, which are four in number, are made of manganese bronze and are attached to a cast iron hub. The thrust of the propeller is received by means of a large ball bearing attached to the



General Arrangement of Engine and Boiler Room

forward end of the gear wheel shaft in addition to an ordinary horseshoe type thrust bearing.

BOILERS

Steam is supplied by three single ended Scotch boilers, two of them being 14 feet 3 inches in diameter and 11 feet 6 inches long, having three corrugated furnaces, and one 12 feet 6 inches in length, having two corrugated furnaces. The boilers are designed for a working pressure of 225 pounds per square inch by gage and to burn either coal or oil alone or coal and oil mixed. Howden's system of forced draft is adopted. Air trunks are led from the generators so that the air for cooling them is utilized. The fan engine mentioned above is to be used only when the generators are not working.

The ship is lighted throughout by electricity and for this purpose there is a set of motor generators taking the current from the main generators and from a steam driven generator when in a harbor.

After the ship was launched several changes were made in the minor parts of the machinery as a result of the experience gained by the engineers who were attending to the fitting out work and installation. She went on the trial trips early in May, 1921, the results of which were very satisfactory. She is expected to run very easily at over 11 knots when fully loaded, with far less consumption of fuel than her sisters equipped with reciprocating engines, and at the same time gaining considerably greater cubic and deadweight capacities of general cargo.

MANAGEMENT ENGINEERING is the title of a new monthly publication issued by the Ronald Press, New York. Its contents are devoted to a discussion of problems of management and production, the object, as stated in the first issue, being "to help executives better to discharge their duties in preparing, organizing and directing industry to secure maximum production." L. P. Alford is editor of the magazine and E. W. Tree, associate editor. Mr. Alford was formerly editor of the *American Machinist* and later of *Industrial Management*. He is a vice-president of the American Society of Mechanical Engineers.

Battleship Maryland to Be the Most Powerful Fighting Craft in the World

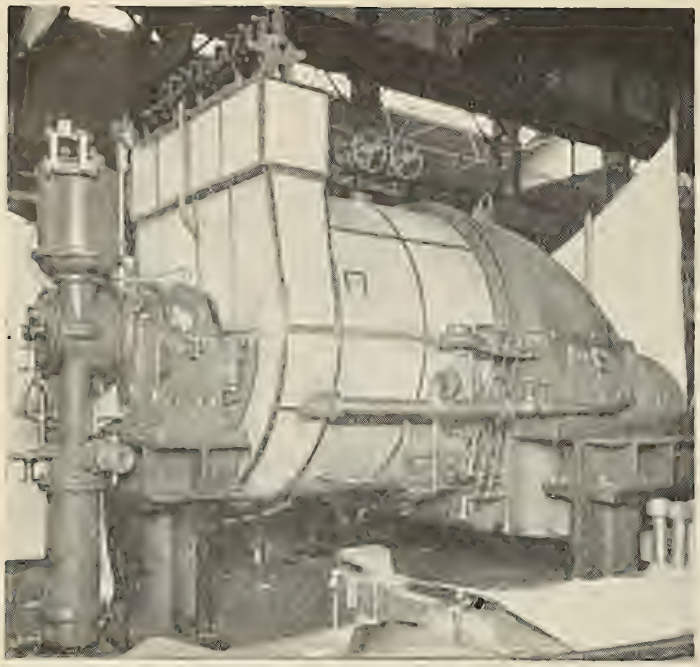
WHEN the United States battleship *Maryland* steams out of Hampton Roads early in November for her official trials, she will be the most powerful fighting vessel in the world as she will carry in four turrets of two guns each eight 16-inch guns, the largest ever mounted in a battleship. These guns are about 57 feet in length and fire a shell weighing 2,100 pounds for a distance of more than 20 miles.

Displacing 32,600 tons, the *Maryland,* electrically driven, will have a speed of 21 knots and a cruising radius of 10,000 miles. She will burn oil, her fuel capacity being approximately 1,392,200 gallons. She is the third in the order of completion of the electrically propelled battleships for the Navy. She was built by the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., and the electrical equipment was designed and manufactured by the General Electric Company, Schenectady, N. Y. The ship was launched on March 20, 1921, and has the following main characteristics:

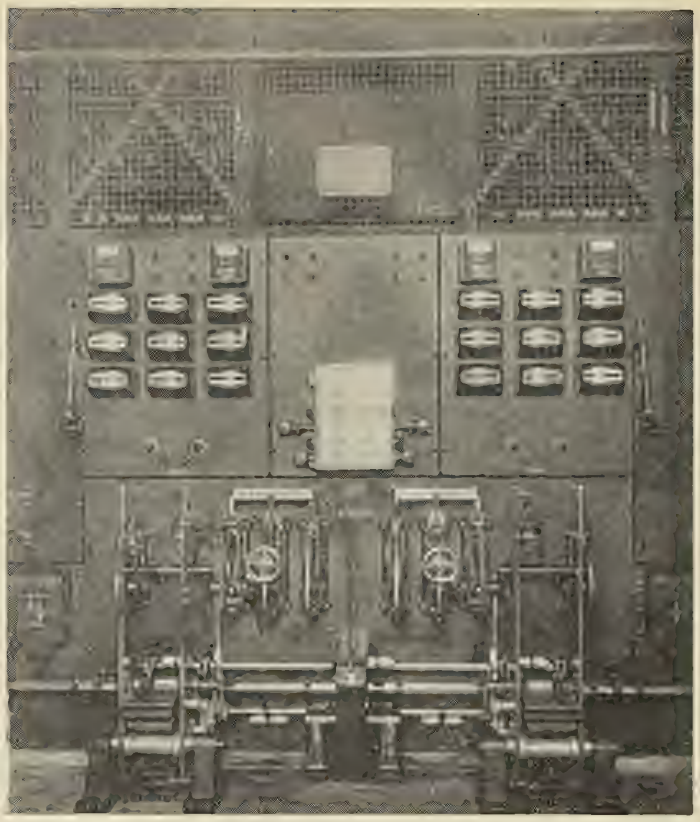
United States Battleship Maryland

Length	624 feet 0 inches
Beam	97 feet 6 inches
Draft	30 feet 6 inches
Displacement	32,600 tons
Speed	21 knots
Number of propellers	4
Shaft horsepower	28,000
Oil capacity	1,392,200 gallons
Oil burning boilers	8
Officers	67
Crew	1,400
Main battery	Eight 16-inch guns
Secondary battery	Fourteen 5-inch guns

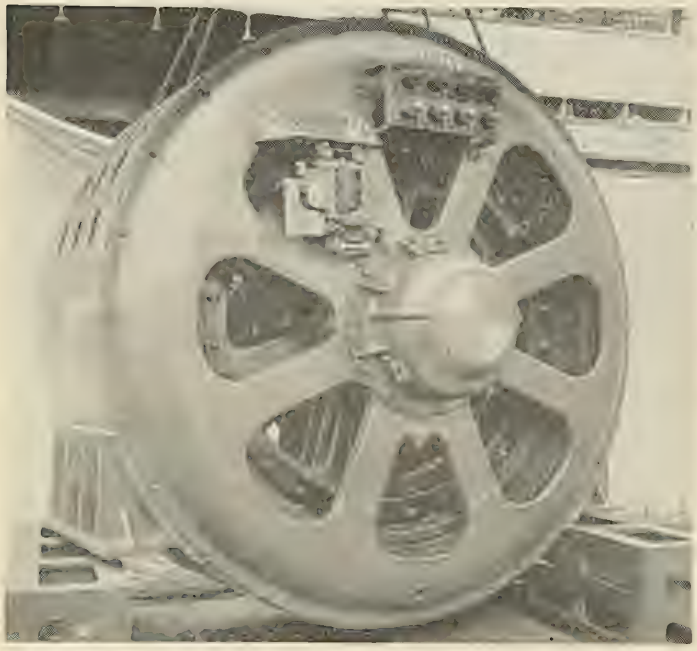
Like her prototype, the *New Mexico,* pioneer electric warship of the world, the *Maryland* is electrical throughout. Her main propelling machinery consists of two Curtis steam turbine generators, each designed to develop 11,000 kilowatts at a speed of 2,030 revolutions per minute to drive the ship 21 knots. These supply power to four 7,000 horsepower Gen-



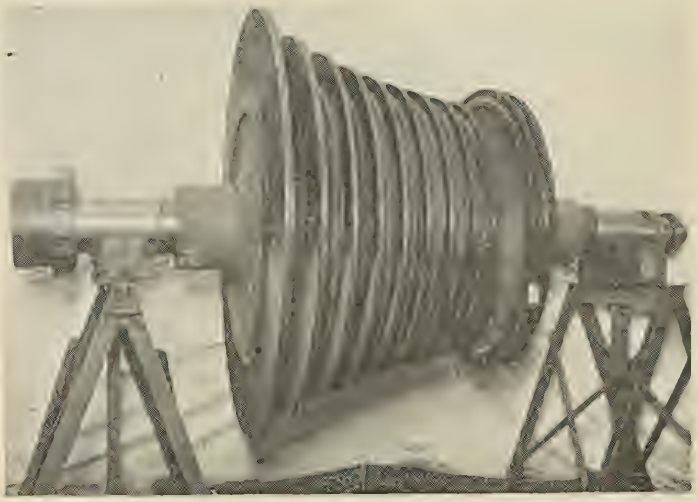
View Looking Aft on Port Side of One of the Maryland's Main Turbines, Showing Arrangement of Unloading Valve, Valve Board, Operating Governor and Oil Pumps and Open Type Check Valves



Control Equipment of U. S. S. Maryland, Showing Electrical Instruments and Operating Levers for Field Steam Reversing, Pole Changing, Field Selective Bus Tie and Emergency Trip



Coupling End of 7,000 Horsepower Propelling Motor with End Shield Screens Removed

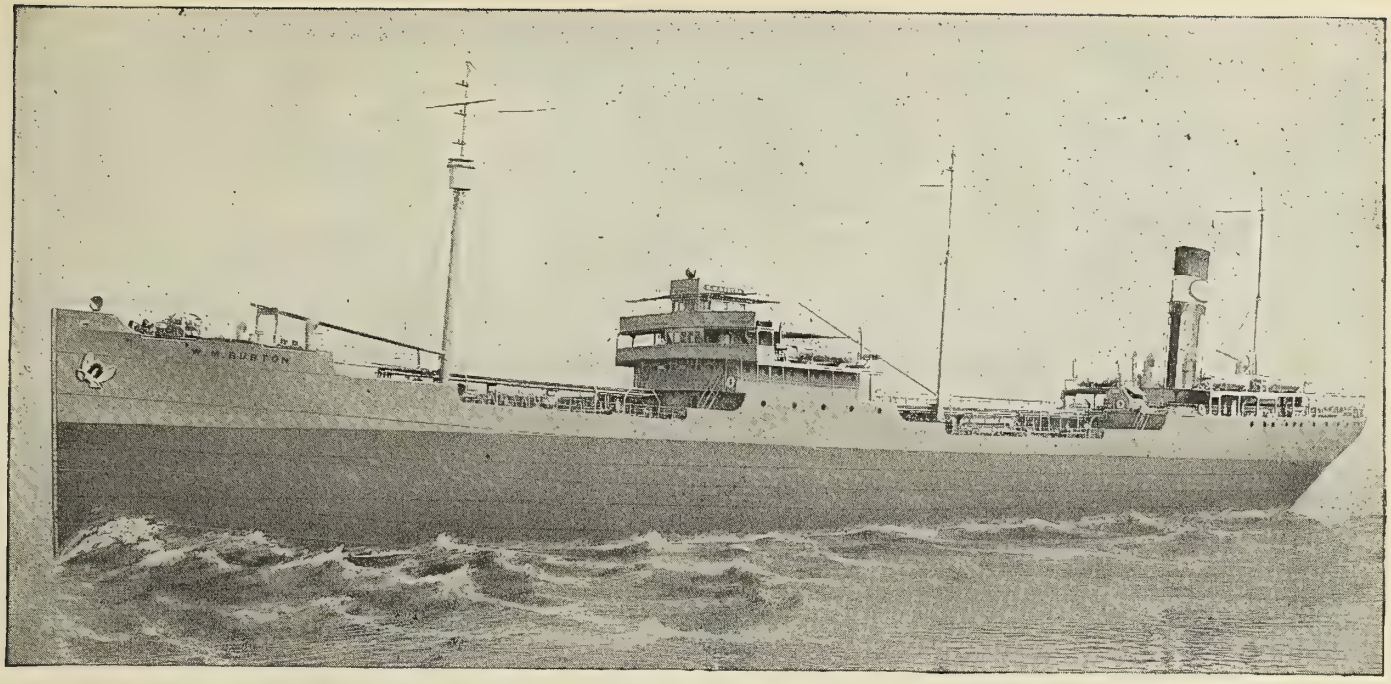


Assembled Turbine Rotor of One of the Maryland's Main Propelling Units

eral Electric induction motors, directly connected with the four propellers and turning at 170 revolutions per minute. The motors, among the largest ever built, are 12 feet in diameter, weigh 62 tons, and the 28,000 horsepower thus available for propulsion purposes is enough to supply power to a city of 100,000 population.

The two turbine generators, supplied with steam generated by eight oil burning boilers, can be run independently. Either is capable of driving the ship up to a speed of about 17 knots. The power generated by them is used for no other purpose than propelling the ship, electrical current for other needs being generated by six 300 kilowatt turbine generators. The electrical equipment includes radio telegraph, loud speaking telephones, ordinary telephones, gyroscopic compass, steering gear, anchor windlass, capstan, boat cranes, winches, air compressors, air heaters, turret training, turret gun elevating, ammunition hoists, gun firing, range signalling, powder testing oven, common deck fans, ice machines, laundry equipment, carpenter shop, lighting, visual signals, motion pictures, sterilizer in operating room, potato peeler, ice cream freezer and other kitchen utensils, bake ovens, irons for laundry and tailor, storage batteries, motor boat ignition, etc.

Four more battleships of this type are being built, the *California,* to be completed this summer; the *West Virginia,* to be ready for her trial trips in 1922; the *Colorado* and the *Washington.* In addition the Navy is building six 43,000 ton, 60,000 horsepower battleships and six battle cruisers, rated at 180,000 horsepower each.



10,500-Ton Tanker W. M. Burton: Length 735 Feet, Beam 56 Feet, Mean Draft 27 Feet, Depth of Hold, 33.6 Feet

New Machinery for Atlantic Refining Tankers

10,500-Ton Tank Steamers Refitted With De Laval Double Reduction Gears and Turbines

FIVE 10,500-ton tankers, the *W. M. Burton, Herbert L. Pratt, J. E. O'Neil, W. M. Irish* and *H. C. Folger,* which were built for the Atlantic Refining Company in 1917 and 1918 by the Union Plant (San Francisco) of the Bethlehem Shipbuilding Corporation, Ltd., are being fitted with new propelling machinery consisting in each case of a set of De Laval cross compound turbines of the impulse type divided into high pressure and low pressure sections and connected to a single propeller through a set of double reduction one-plane speed reduction gears. The original geared turbine machinery installed in these vessels was rated at 2,600 horsepower.

In making the change, the Atlantic Refining Company decided to increase the horsepower in order to obtain higher speed from the tankers. The new propelling units, therefore, are rated at 3,300 horsepower each and are designed to give the vessels, which are 435 feet long, 56 feet beam and 33.6 feet depth of hold, a speed of 11 knots on a 27-foot mean draft.

Each turbine delivers its full power at a speed of 3,300 revolutions per minute on both the high and low pressure elements. The reduction of this speed of the turbines to the 90 revolutions per minute of the propeller is accomplished in two steps, making the total reduction ratio 35.5 to 1. The direction of rotation of the slow speed gear shaft is clockwise when viewed from the after end.

The Turbines

The high and low pressure turbine elements are so arranged that they can be operated independently of each other in case of emergency by means of a flexible throttle control. Both high pressure and low pressure turbine rotors are connected to separate pinions. The high pressure turbine element for ahead operation is equipped with one velocity stage and seven pressure stages. The low pressure element for ahead operation consists of six pressure stages. One reversing element is located in the high pressure turbine which operates in series with a reversing element located in the low pressure turbine.

Full power is developed at a steam pressure of 200 pounds gage with a superheat of 50 degrees F. and a vacuum of 28 inches. Each turbine section develops one-half of the full rated power for running ahead. The astern power developed is two-thirds of the full ahead torque.

Operation

Steam is admitted through a strainer to a valve under control of speed governors located on the forward end of both high and low pressure turbines. These governors are set to bring the governor valve into operation when the speed reaches 10 percent above normal. When brought into operation this governor does not entirely cut off steam, as an emergency trip would do, but holds the speed below a safe limit without shutting down the unit.

From the governor valve steam passes into the ahead or astern nozzle of the high pressure section, passes through the stages of this section and is returned through cross connecting piping to either the ahead or astern nozzle chambers of the low pressure section, exhausting from there into the condenser.

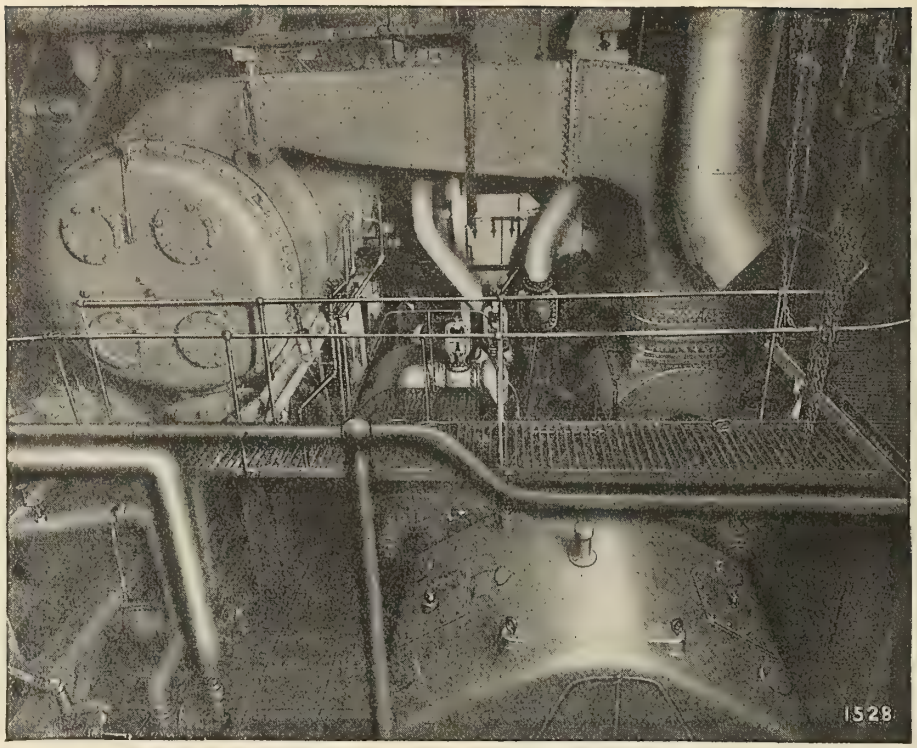
The maneuvering valves are balanced vertical spindle valves and control the steam to the ahead and astern elements of the turbine. The valves are operated by hand wheels and are interlocked so that only one of the valves can be operated at a time. Hand valves for further controlling the steam supply to the first stage nozzle of the high pressure section when less than full speed is desired are installed.

Leakage through the throttle valve of steam to the astern element when driving ahead for considerable periods of time is prevented by a guarding valve which is operated from the

main operating platform.

The cross connecting piping between the two turbine sections is so constructed that the operating engineers can make proper steam supply connections so as to operate either the high pressure turbine or the low pressure turbine separately in case of emergency.

The turbine wheel case is supported in such manner that it is free to expand in all directions without changing the position of the axis, so that the centerline of the wheel case and the centerline of the shaft coincide under all conditions. It is therefore possible to start the turbine quickly and safely, without danger of rubbing, vibration or other troubles due to distortion by heat.



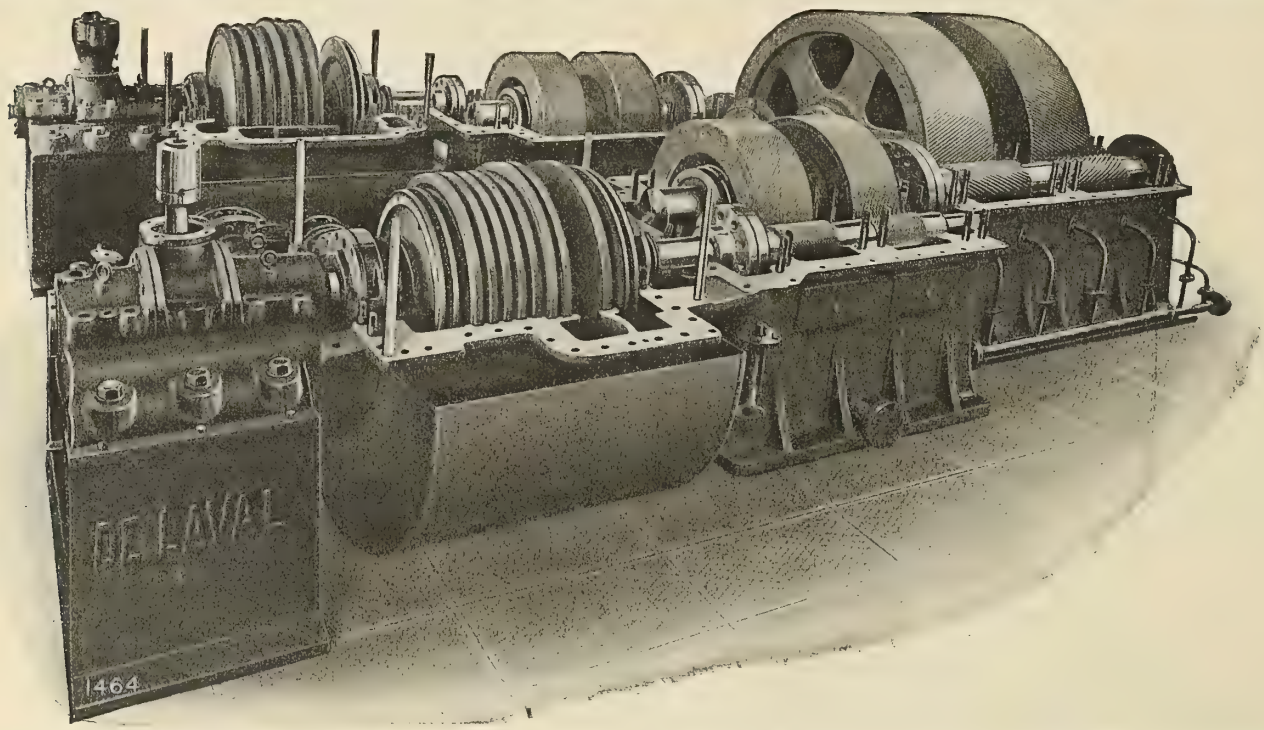
View Looking Forward from Above Propeller Shaft in Engine Room of S. S. W. M. Burton

Ample bucket clearances both axially and radially are provided so that the danger from internal rubbing is reduced to a minimum.

The Reduction Gears

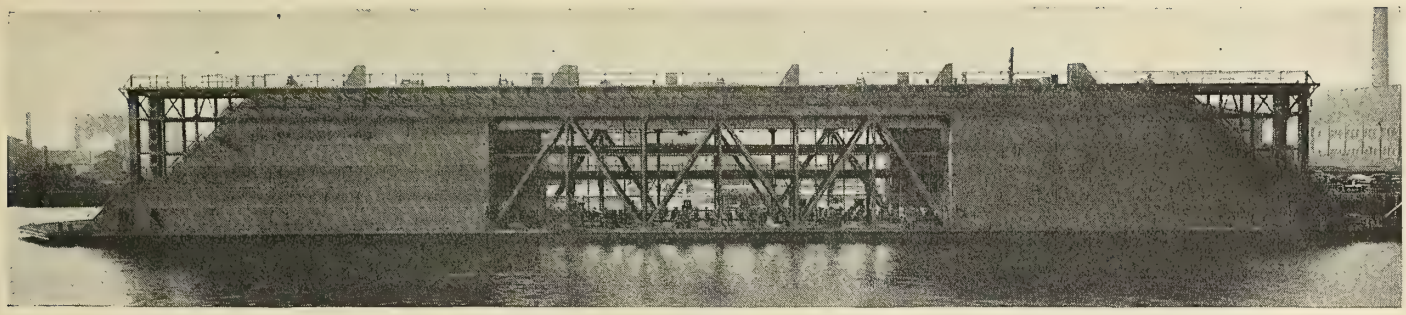
The speed reduction gears are mounted directly abaft the turbines and are divided into two elements, the high speed element and the low speed element. The high speed reduction consists of two parts in two separate casings, one of which is bolted to the low pressure and the other to the high pressure sections of the turbines. De Laval pin couplings which provide for free axial motion connect the turbines to the high speed pinions. The low speed gear with pinions is contained in one casing. The high speed and low speed gear cases are entirely independent of each other, the high speed gears being connected to the low speed pinions by means of a De Laval rubber bushed flexible coupling which gives proper compensation for any slight inequalities of alinement which may develop in the operation of the gear.

Both high speed and low speed gears are designed for low tooth pressure and ample factors of safety. The pinions are made from nickel steel forgings and the gears consist of cast iron centers upon which are shrunk seamless rolled steel bands in which the gear teeth are cut.



De Laval 3,300-Horsepower Compound Double-Geared Marin Turbine; with Covers Removed to Show Turbine Rotors and Gears; Turbine Speed 3,200 Revolutions per Minute, Propeller Speed, 90 Revolutions per Minute

All parts entering into the construction of these propelling units are manufactured to limit gages and are interchangeable. This feature will appeal particularly to marine engineers. The operation of these propelling units was uniformly successful on the trial trip of the *W. M. Burton* and a speed



One of the Floating Dry Docks at the Danziger Werft

of 11.77 knots was obtained. Since the trial trip, the *W. M. Burton* has been in continuous service and the propelling equipment has operated to the satisfaction of the owners.

On account of the anticipated low steam consumption the original condensing equipment which was installed in connection with the original 2,600 horsepower propelling units was not changed as the total steam consumption of the new units rated at 3,300 horsepower was not greatly in excess of the total steam consumption of the original 2,600 horsepower units. On the trial trip the condenser was found amply large to take care of all the steam used by the new unit and satisfactory vacuum was obtained.

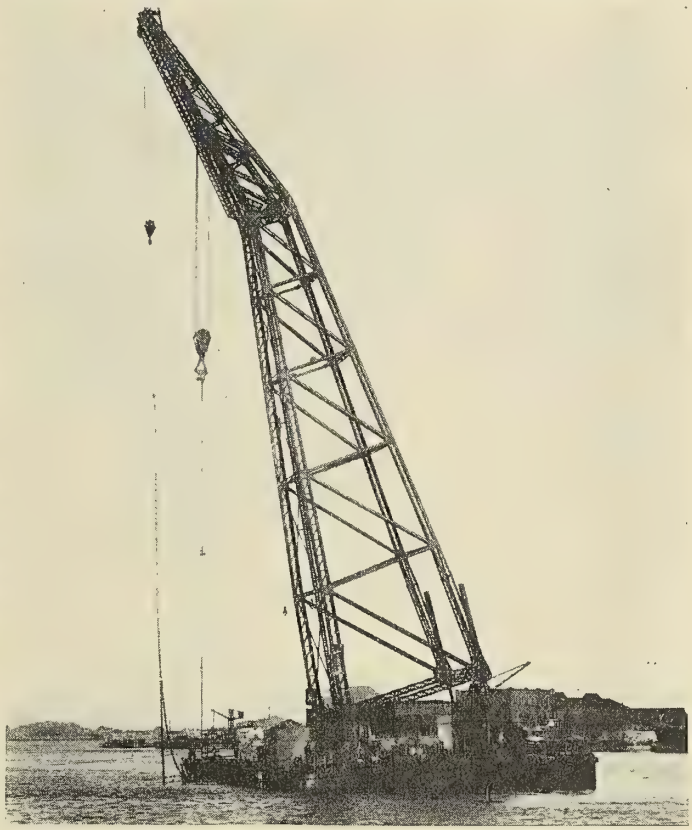
Shipyards at Danzig Active

THE Danziger Werft, Danzig, Germany, is at present engaged in building small craft and repairing and refitting certain of the cargo vessels and cruisers which Germany has been permitted to retain in service. Nearly 3,500 men are employed at the plant. There are four building ways, each about 320 feet long, and three wet docks for fitting out vessels. Only one freighter of 2,050 British registered tonnage is being built, but a number of small craft, including two seagoing steel tugs, six trawlers and four gunboats for Poland, are under construction. The ways are equipped with four tower cranes each of five tons capacity.

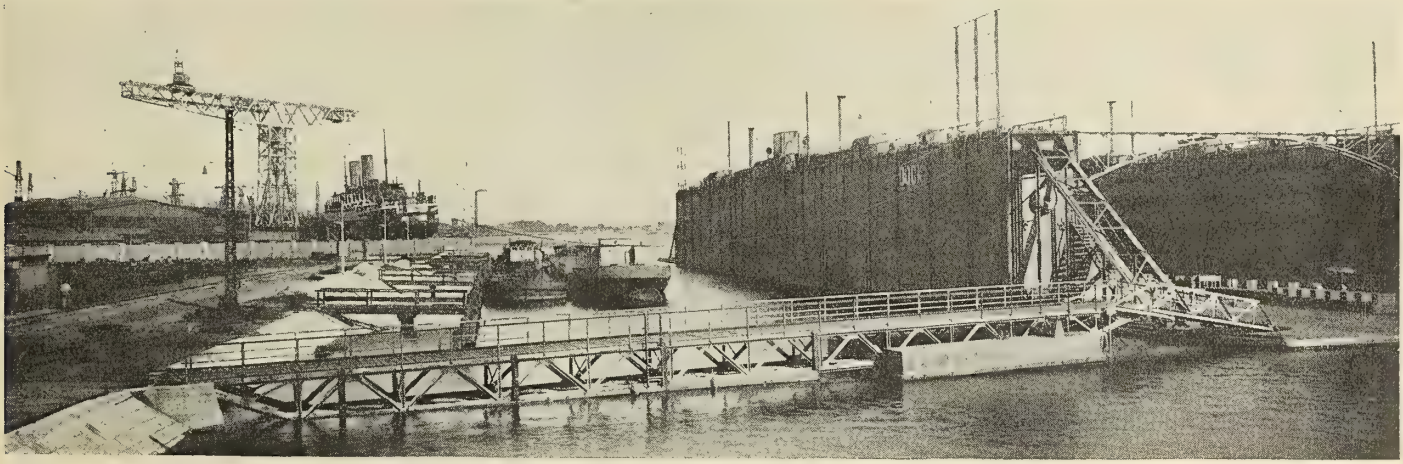
The engines for the ships are also built at the plant. In addition to this work, 115 Baldwin locomotives and 25 steam cranes of the Brown Hoisting Machinery Company have been assembled.

In the repair section three obsolete type German cruisers are being rebuilt as freighters. Most of the repair work to be done at the port of Danzig is brought to this yard. In the repair section there are three drydocks 420, 390 and 250 feet long of 5,800 tons, 3,500 tons and 1,200 tons capacity respectively. The punch and shear shops, the blacksmith shop, the foundry, the coppersmith shop, the boiler shop, the joiner and welding shops are all well equipped for this sort of work and located so that fabrication of parts can be carried out in the most expeditious and efficient manner.

In the welding and cutting shop electrolytic cells of the Linde system are installed, which supply 18,000 cubic feet of oxygen and hydrogen a day. Air for the pneumatic tools is distributed over the yards in an extensive piping system.



100-Ton Floating Crane at Danzig



Repair Section of Danziger Werft, Danzig, Germany

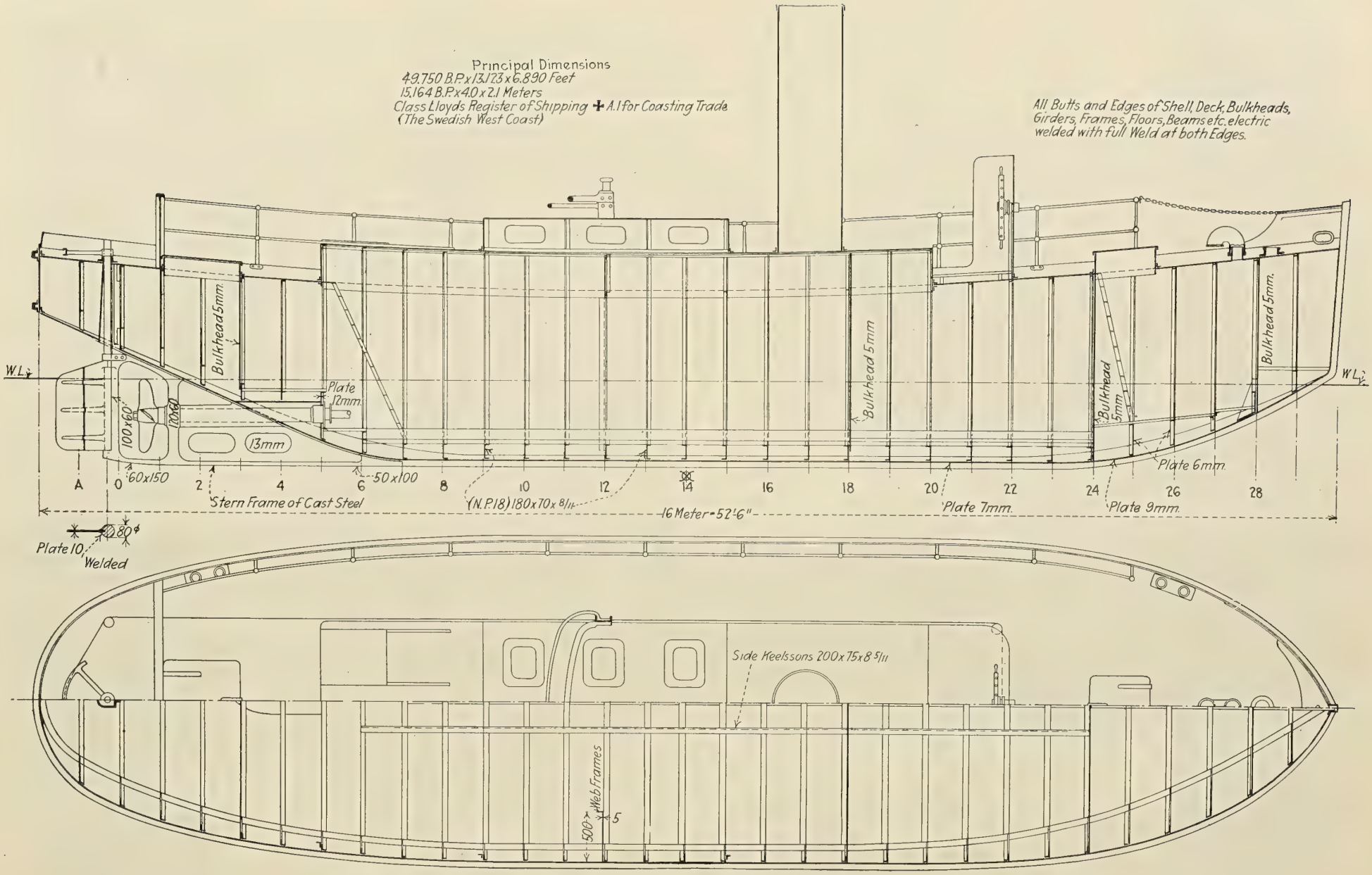


Fig. 1.—Inboard Profile and Deck Plan of Electrically Welded Motorship Esab IV

Electrically Welded Motorship Esab IV*

By Oscar Kjellberg

In order to gain experience in the application of electric arc welding to shipbuilding and to test the utility of the regulations for welding issued by Lloyds and other classification societies, the board of directors of the Elektriska Svetsnings Aktiebolaget (Electric Welding Company, Ltd.) at Goth nburg, Sweden, is building a 50-foot boat in which welding will be substituted for ri eting. Although the experimental vessel is of small dimensions, the form is such as to introduce a number of large flat plates with a view to obtaining information relative to the efficiency of welding for the flat bottom and sides usually found in modern steamships.

PLANS for the steel motorship *Esab IV,* which is 52 feet 6 inches long overall, 49 feet 9 inches length between perpendiculars, 13 feet 1½ inches beam and 6 feet 10½ inches depth, were prepared by Professor A. H. Lindfors for the Elektriska Svetsnings Aktiebolaget, Gothenburg, Sweden, and submitted to Lloyd's Register, the Bureau Veritas and the Swedish Board of Trade for approval for construction of the vessel under special survey to the highest class. The shape of the bottom, bilges and, to a certain extent, sides is different from the usual practice, but this form was chosen for the purpose of obtaining some experience in this small vessel of the behavior of large plates and plane surfaces with welded connections which otherwise could be obtained only in a very much larger vessel.

Method of Welding

As shown by the detail sketches the bottom plating is lapped on the keel and welded, the plates at the bilge overlapped and welded to an inside angle bar and all seams of the shell plating overlapped and welded. The butts of the bottom are also overlapped but at the sides the plates are placed end to end and butt welded, the frame flanges serving as butt straps. Butts and seams of the deck plating are also butt welded, the seams being strapped by a T-bar extending from beam to beam and the butts located on the deck beams.

There are 5,850 feet of welded connections in the vessel. The welded overlaps are, however, considerably smaller than riveted overlaps. All welded connections are welded with full welds except in the engine casing, where broken or spot welding is applied. The full weld has great advantages not only in regard to strength, but also in preventing the parting of plates due to rusting between the surfaces. It is considered advisable in regard to safety as well as maintenance to apply full welds to all connections below the main deck. For the welding of casings and bulkhead stiffeners, etc., the easier and cheaper system, which is approved by the classification societies, might be used.

Full welds are made overhead without any difficulty so that the use of a light fillet is not necessary.

All connections in the hull, including deck and casings, are welded, only the skylight being bolted to the casing top in order to facilitate shifting when heavy parts of the machinery are to be lifted in or out. The machinery of the vessel consists of an oil motor of about 40 brake horsepower adapted for driving either the propeller or two generators for electric welding. In addition there is an oil motor driven air compressor for supplying power to the pneumatic tools.

Conclusion

The building and welding of this vessel has not been carried out contin-

*From a paper read before the Association of Naval Architects, Stockholm, Sweden, May 4, 1921.

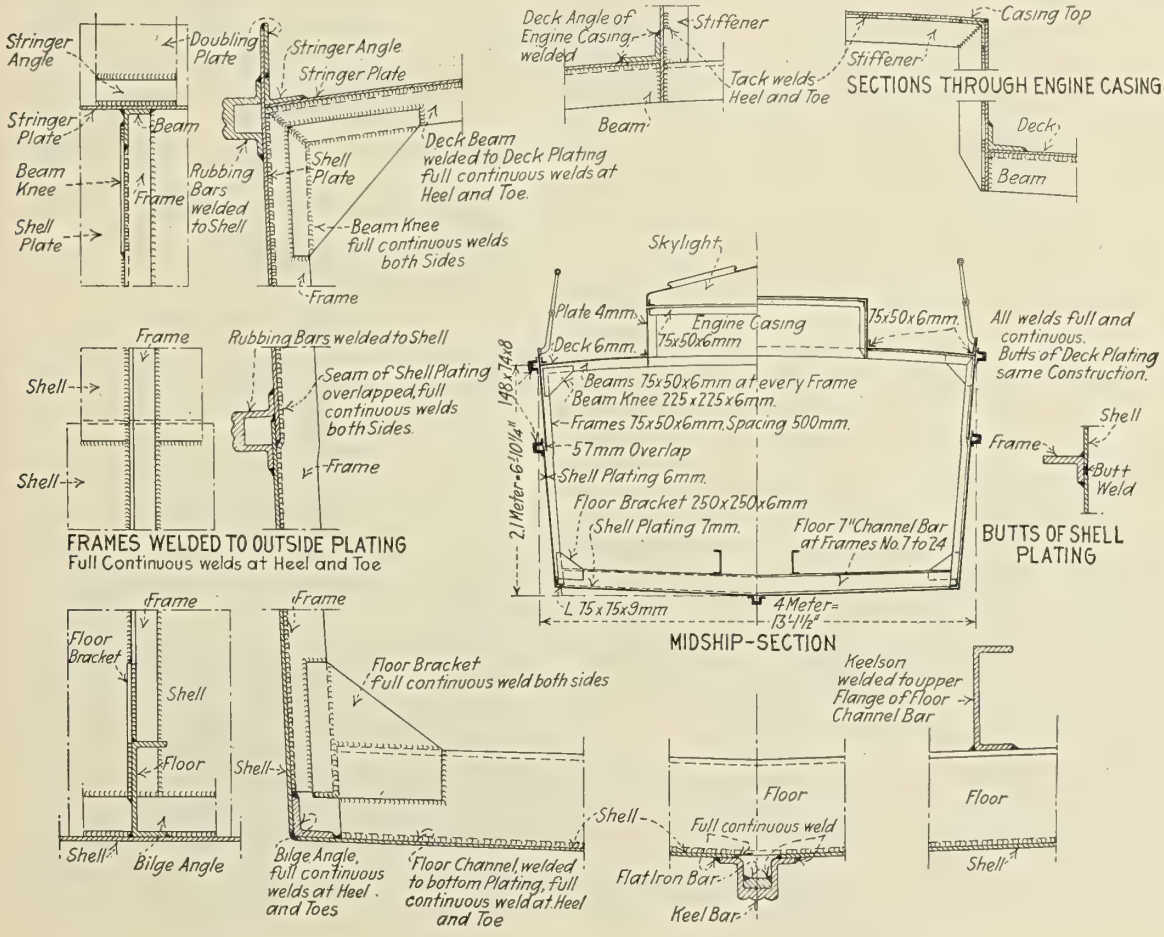


Fig. 2.—Midship Section and Details of Welding, M. S. Esab IV

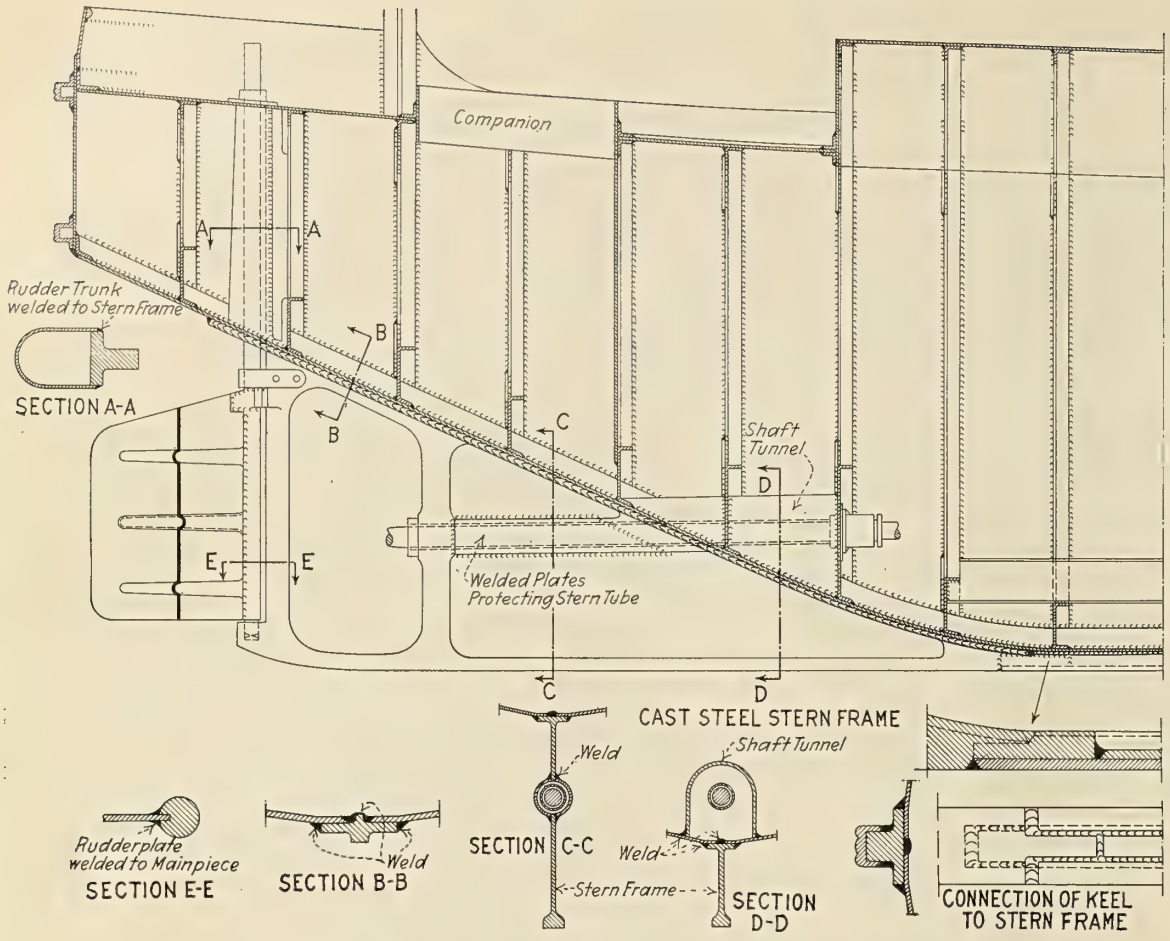


Fig. 3.—M. S. Esab IV: Details of Welded Connections at Stern

uously but has been done in leisure hours. For this reason no accurate costs have been obtained and the actual costs have naturally risen somewhat higher than they would have if the work had been going on without interruption. Nevertheless it can be said that the results of the comparisons which have been possible indicate that in shipbuilding on a larger scale electric welding is able to compare favorably with riveting in regard to cost. Moreover there are the great advantages on the side of electric welding that the welded connections are considerably stronger and tighter than riveted joints and that a saving of material can be effected which is not to be despised.

It might be stated that the welding in the *Esab IV* exceeds materially the demand of the classification societies. The reason for this is the special service for which the vessel is intended, for as a floating workshop it will often be moored between large ships and will in this position be serving as a fender between them.

Locking Device Gives Stockless Anchors Positive Gripping Action

IN order to overcome the disadvantage experienced by the stockless anchor dragging over the ground without holding, a locking device has been perfected by the American Steel Foundries, Chicago, Ill., which restores what might be called the "hook" action possessed by the old type anchor. In the latter case the combined weight of the anchor shank, stock and chain tends to hold the point of one of the flukes in contact with the ground. When the stockless type was developed this positive grip on the ground was lost because it was found necessary to swivel the shank to the flukes, so that the flukes might fall in the direction of pull of the vessel. Since the flukes were not held rigidly at an angle with the bottom and the shank simply rested on the ground without forcing the flukes to dig in as in the old type, the anchor had a tendency to drag along the ground before it would grip effectively.

The device shown in the accompanying illustrations was developed to overcome this difficulty by automatically locking the shank of the stockless anchor to the flukes when the anchor is in its holding position. It also automatically releases the flukes when the shank is in the vertical position. It accomplishes this by means of two counterweighted pawls attached to either side of the shank which engage with dogs on the flukes. The pawls act in opposite directions, only one being engaged at a time so that whichever way the flukes fall, the shank is immediately locked. Now when the anchor drags, the angle which the flukes make with the bottom is so

Fig. 1.—With Shank in Vertical Position Counterweights Disengage Pawls Permitting Flukes to Rotate Freely in Either Direction

Fig. 2.—With Shank in Horizontal Position Pawls Lock the Flukes at an Angle with the Shank Causing the Anchor to Grip the Bottom

great that they are forced to dig in immediately. When the shank is raised to a vertical position the head of the pawl is carried out of a depression on the anchor and the counterweight prevents it from dropping back into the depression until the anchor is again in the holding position and the shank lowered to the horizontal. When the anchor is brought up to the ship the locking device is automatically disengaged and the flukes are free to rotate. The device is designed so that the pawls will not interfere with the stowing of the anchor in the hawse-pipe.

In a comparative test recently held with a 4,000 pound stockless anchor and a 3,000 pound anchor equipped with the locking device, the latter began to bury itself before it had been dragged more than two or three feet while the anchor without the lock was dragged about forty feet without showing any signs of digging in. The device has been approved by both the American Bureau of Shipping and Lloyd's Register of Shipping. This locking device was originated by A. Trevor Jones, American Steel Foundries.

6,000-Ton Floating Dry Dock at Sparrow's Point

THE Bethlehem Shipbuilding Corporation, Ltd., completed in February of this year their second floating dry dock at the Sparrow's Point plant, Sparrow's Point, Md., the construction of which was a part of the original project for the operation of two docks at that point, within the Baltimore district. The first floating dock

The First Vessel to Be Docked in the New 6,000-Ton Dock at Sparrow's Point

at Sparrow's Point (described on page 661, *Marine Engineering*, October, 1919) was put in operation in March, 1919, and has a lifting capacity of 20,000 tons.

The new dock has a capacity of 6,000 tons, is 418 feet in length by 100 feet in width, and is suitable for taking a vessel of 20-foot draft. It is located alongside of the 20,000-ton dock, making use of the pier and bulkhead planned and constructed for this purpose when the concrete work for the larger dock was put in. The piers at either side of the two docks have pile foundations and extend out into the bay a distance of 1,260 feet. Material in the new dock is handled by means of a locomotive crane.

Type of Construction

In type of construction the new dock is similar to the 20,000-ton dock, being of the pontoon type, with individual wooden pontoons and continuous side wings of steel. There are eleven pontoons, which are attached to the side wings in such a manner that the wings act as continuous girders extending the full length of the dock. Each pontoon is

View from Bay Showing the Two Floating Dry Docks at Sprrrow's Point Plant at Bethlehem Shipbuilding Corporation, Ltd.

divided into two compartments by a watertight bulkhead passing through its center lengthwise of the dock, and has a centrifugal pump located in each compartment for use in emptying the pontoons and raising the dock. The pumps are electrically driven, being direct-connected to motors vertically mounted in watertight casings on the decks of the side wings.

A double control house on shore, from which the motors are controlled, houses the electrical switching apparatus for both the 20,000-ton dock and the 6,000-ton dock. Electrical connections are such that by means of individual switches the pumps of any pontoon can be operated independently of those of the others, or by means of a master switch the pumps of all pontoons can be operated simultaneously. This feature provides means whereby the stresses in the vessel being docked may be equalized by utilizing the individual control and bringing a decreased or increased upward pressure to bear on certain pontoons, as required.

Method of Submerging

For filling the pontoons and submerging the dock, a gate valve is located in each end of each pontoon so arranged that the water is allowed to enter through the pump ports, but is by-passed into the dock to avoid passing through the pumps. Suitable screens are provided to prevent any material entering that would interfere with the operation of the pumps. Operation of the gate valves is by hand from hand wheels located on the decks of the wings.

The wings are 30 feet high and 12 feet wide at the base. They are of watertight construction and communicate at the base with the compartments of the pontoons. The dock is moored to the pier and bulkhead by moorings of steel construction anchored in the concrete.

Warping Equipment

Three electrically driven gypsies are located on the deck of each side wing for the purpose of warping ships into the dock, a double bitt being installed at each gypsy for use as a fair lead. The electric motors for driving the gypsy heads are located in the wings below the decks and are direct connected by shafting and gears to the gypsies.

William T. Donnelly, consulting engineer, of New York, prepared the plans for the dock and the construction work was done by the Sparrows Point plant of the Bethlehem Shipbuilding Corporation, Ltd. The first vessel docked was the *Higho,* on February 15. The operation of the dock has been very successful and its completion materially adds to the facilities of Sparrows Point for the quick handling of marine repair jobs of any calibre.

Two Notable Features in a Propeller Repair Job

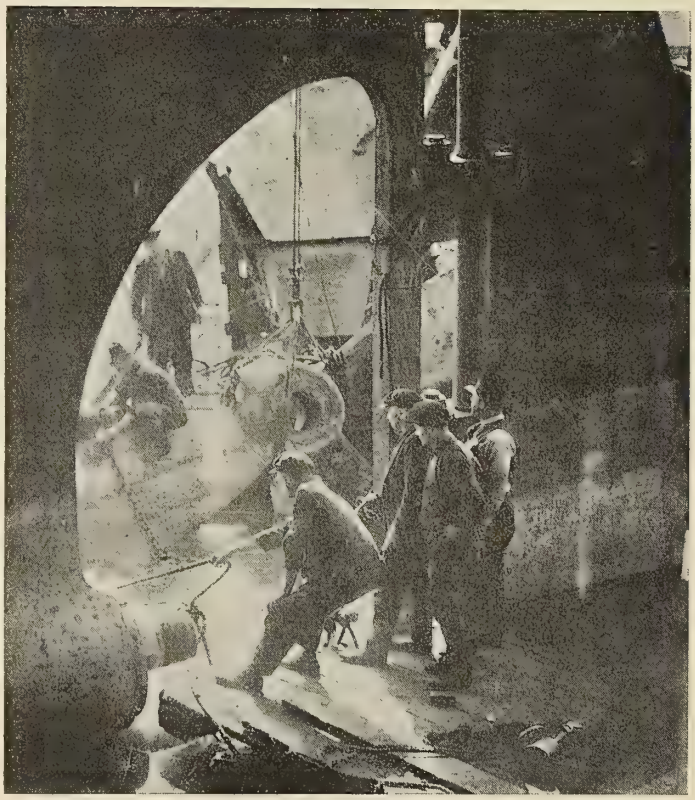
WHEN the S. S. *Trialos* limped into Philadelphia some time ago minus one of its propeller blades it was feared the vessel would have to be dry docked. To avoid this expense the following expedient was successfully employed:

By removing everything possible from the after portion of the ship the bow was sufficiently lowered so that water pumped into the hold would accumulate forward. The pumps were then started and, as the volume of water increased the load in the bow, the vessel gradually lifted astern. When the keel angle was such that the center of the propeller shaft cleared the waterline 12 inches, one section of the shaft was removed in the shaft alley and the aft section of the shaft jacked forward to provide clearance between the rudder post and the shaft end for wedging off the propeller.

Everything went forward as planned until the wedging-off process was attempted, when the hub was found to be so badly frozen to the shaft that it successfully resisted every attempt to budge it. After twelve hours of gruelling effort this mode of procedure was abandoned and an oxy-acetylene welding blowpipe was used in an attempt to heat the hub and loosen it by expansion; but, due to the size of the casting and its partial immersion in water, nothing could be accomplished.

New Method Tried

Having exhausted the usual expedients in such cases, it was decided to try an entirely new procedure that until within the past year was thought to be impossible, and which even more recently was thought to have but little practical value commercially, viz.: oxy-acetylene castiron cutting. The hub was an iron casting, and if this could be cut without injuring the shaft the broken propeller could be removed and a new one shrunk on in its place. Upon the advice of the Oxweld Acetylene Company this method was tried.



Broken Propeller Removed Without Dry Docking Vessel

In 25 minutes' actual cutting time a slot 5 inches deep and 32 inches long was made across the hub, leaving about 3 inches of the casting still covering the shaft, when the strain cracked the uncut portion through to the shaft. It is interesting to note that, when the cut had almost reached the opposite side of the hub, the wedges used caused the propeller to jump two inches on the shaft, after which removal was a simple matter. Two hundred cubic feet of oxygen and about 60 cubic feet of compressed acetylene were consumed in the operation, which was accomplished in less than an hour.

It is believed that this is the first time the blowpipe has been used for this specific purpose, but it is only one of a constantly increasing number of instances that conclusively disprove the early assumption that cast iron cutting is merely an interesting scientific discovery of no particular practical commercial value. It is very rapidly developing a definite field of usefulness in this day of advanced engineering economics.

Piping, Valves, Flanges and Fittings

By Horace Holden Thayer*

This is the third of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the various classes of workers who have to deal with these materials from the materials point of view. This article covers the materials used in the various systems of piping on board ship.

PIPING, together with its accompanying flanges, fittings and valves, is of sufficient importance from a materials point of view to warrant separate consideration in this series of articles. Although in many cases the material to be used is not determined by hard and fast rules, it is governed to some extent by the type of the vessel, the individual preferences of the owner and other considerations. There are, however, definite requirements, outside of those of the specifications to which the vessel is built, which have to be obeyed and which should always be consulted. Those for this country are embodied in the Rules and Regulations of the United States Steamboat Inspection Service. Classification requirements also enter definitely where the vessel is classed and should be used as guides where not classed.

The accompanying table covering pipes, flanges and fittings has been prepared as a guide to good merchant practice and will be found to be of value when so used. In cases where two or more materials are listed for a particular service they are of approximately equal value as far as good practice is concerned. Most of the following paragraphs are written to throw light upon the table and they contain information which is felt to be helpful to a proper analysis and use of the table. The table will be found on pages 608-611.

Pipes

The three principal pipe materials for the more important shipbuilding services are wrought steel, wrought iron and copper. Their relative values from different points of view are as follows, the first mentioned having the highest value:

(a) Strength for a given weight or cost .... Steel, Iron, Copper
(b) Low first cost ..... Steel, Iron, Copper
(c) Resistance to corrosion ..... Copper, Iron, Steel
(d) Flexibility ..... Copper, Steel, Iron
(e) Surface smoothness ..... Copper, Steel, Iron

On account of the last mentioned consideration steel pipes present a somewhat better appearance and less internal frictional resistance than iron pipes.

The fact that properly made iron pipe resists corrosion better than steel pipe is well established, regardless of arguments that may be advanced as to why it should not do so. For this reason iron pipe is listed in the table in preference to steel pipe in all cases where internal or external corrosion is an important factor, not counterbalanced by the necessity for seamless pipe.

The reliability of piping is largely a question of the manner in which it is made. Seamless drawn pipes are the most reliable. Steel of such sizes as are required on shipboard and copper and brass pipes up to and including 10 inches, of this nature, can be readily obtained. Wrought iron pipes have to be welded; larger sizes of copper pipes are made up from sheet copper and brazed; and larger sizes of brass pipes are not used. The sheet copper for the copper pipes should be hot rolled. Welded iron or steel pipes 2 inches in diameter and over for almost all services should be lap welded. This is a requirement of the United States Steamboat Inspection Service for steam and water pipes over 2 inches in diameter over which they have jurisdiction. Butt welded pipes can be used in most cases where under 2 inches in diameter and in the accompanying table no reference to the welding will be made where this is in order. Where lap welded iron or steel is specified in the table this type of welding should be used for all pipes down to and including 1¼ inches in diameter.

Copper pipes have the advantage of being readily shaped to accommodate necessary curves in the line of self incorporated expansion bends and of reducing the use of fittings to a minimum.

Lake Superior copper is the standard for copper pipes and it can be readily obtained 99.5 percent pure, which purity should be called for. The copper should be free from sulphur.

In the fall of 1918 various users of copper tubing, including the United States Navy Department and the United States Shipping Board Emergency Fleet Corporation, agreed to reduce materially the great number of sizes and thicknesses specified by them up to that time and to adopt the sizes and thicknesses of copper tubing below listed and in the future to specify no other for ordinary purposes.

Standard Sizes and Thickness of Copper Tubing

Inside Diam., Inches	Thickness	
	High Pressure	Low Pressure
1	12 B.W.G.	12 B.W.G.
1½	11 B.W.G.	12 B.W.G.
2	9 B.W.G.	12 B.W.G.
2½	8 B.W.G.	12 B.W.G.
3	7 B.W.G.	12 B.W.G.
3½	6 B.W.G.	12 B.W.G.
4	4 B.W.G.	12 B.W.G.
5	2 B.W.G.	12 B.W.G.
6	0 B.W.G.	11 B.W.G.
7	000 B.W.G.	11 B.W.G.
8	0000 B.W.G.	10 B.W.G.
9	0.506 inch	9 B.W.G.
10	0.562 inch	9 B.W.G.

As regards transmission of heat through the walls of the pipe, copper is in a class by itself, its conductivity being about two and one-half times that of iron and greatly superior to that of brass alloys made from it.

Provision for expansion should be made in all steam, exhaust and hot water pipes and in long leads of large pipes generally, either by expansion bends or expansion joints.

On account of the difficulty of properly coating the inside of pipes by electro galvanizing, pipes should be galvanized by the hot process. Galvanized flanges should be used with galvanized pipes and the ends of the pipes should be dipped after the flanges are on.

Pipes should be arranged to avoid pockets as far as possible and provision should be made for the proper drainage of all low points. The main value of this is to guard against damage from freezing but pocketed liquids in pipes are also objectionable on other grounds.

As a general rule piping 2 inches in diameter and over should have flanged end connections and fittings; piping under 2 inches in diameter, screwed end connections and

* Member of Rossell and Thayer, Naval Architects and Marine Engineers, Philadelphia, Pa.

fittings. Screwed fittings are allowable for low pressure service up to and including 3 inches in diameter, but 3-inch screwed fittings are not standard practice except for such service as bilge piping. There are also special cases where standard screwed end connections under 2 inches in diameter are not permissible.

Flanges

Flanges for steel or iron pressure piping are generally of forged steel, and for copper pressure piping of brazing metal or forged steel. Cast iron flanges are generally used for steel, or iron, and copper low pressure piping.

The connection of flanges to the more important pipes has to satisfy United States Inspection Service requirements.

Fittings

Unions used in place of flanges on pipes of small diameter are classed as fittings. They are generally of malleable iron and such unions should have ground joints and brass or brass to iron seats. It will therefore be understood that where cast iron fittings are called for in the table the unions used on the pipes under 2 inches in diameter are of malleable iron. Where other fittings are of brass the unions are usually of brass to correspond. Where other fittings are extra heavy the unions are also extra heavy.

A general guide to the selection of fittings is as follows:

	Flanged fittings	*Screwed fittings*
(a) Boiler pressure steam lines	Cast Steel or X Hvy. Composition, or Cast Iron to suit pressure	Forged Steel or Cast Iron to suit pressure
(b) Boiler pressure water lines	Cast Steel or X Hvy. Composition	Cast Steel or X Hvy. Composition
(c) Reduced pressure steam lines on open deck and supply or pressure lines generally	Cast iron to suit pressure	Cast iron to suit pressure
(d) Reduced pressure steam lines other than (c) and fuel oil discharge lines	X Hvy. Cast Iron	X Hvy. Mall. Iron
(e) Brass pipe	Brass	Brass
(f) All others including suction lines generally, except for ammonia and similar special services	Std. Cast Iron	Std. Mall. Iron

It will be noticed that malleable iron is extensively used for the screwed fittings on small pipes but that cast iron is considered preferable for such fittings when on pressure lines.

Galvanized fittings should in general be used with galvanized pipes but when they are of cast iron and have a metal thickness of ½ inch or more the galvanizing may be dispensed with.

Valves

Valves for superheated steam have cast steel body and bonnet and forged steel crosshead, the other parts being preferably of compositions stated in the writer's article on "Non-Ferrous Metals and Alloys" in the July issue. Other high pressure valves and low pressure valves are preferably compositions as there stated, although the latter in most cases when in sizes of 2 inches and over may have cast iron bodies. Moderate pressure valves, except for superheated steam, may also be of some such composition as ferrosteel. Valves 2 inches and above should in general be flanged and those below 2 inches screwed. The catalogues of standard manufacturers of valves are excellent guides to a proper selection of valves of the various types, as these manufacturers produce for the many uses only what will meet the requirements of the different classification societies and the United States Steamboat Inspection Service.

The following is a good guide to body materials for the general run of valves:

Cast Steel—	All valves subject to superheated steam; steam valves and feed discharge valves 2 inches and above subject to boiler pressure; boiler blow valves at boilers; throttle valves.
Extra Heavy Bronze—	All valves below 2 inches subject to full boiler pressure except boiler blow valves at boilers and valves in superheated steam lines.
Ferrosteel or equal—	Valves 2 inches and above in reduced pressure steam lines except on open deck; oil pressure valves, 2 inches and above; ammonia valves.
Bronze—	Valves below 2 inches in reduced pressure steam lines except on open deck; oil pressure valves below 2 inches; sea valves and cocks.
Brass—	Valves and cocks for all except a few special services, if not in any of the above lists, when below 2 inches.
Cast Iron, Composition fitted—	Valves and cocks for all except a few special services, if not in any of the above lists, when 2 inches and above.

As stated in the writer's earlier article, the bronze valves should be gun metal when 4 inches and over but may be of valve bronze when 3½ inches and less.

Steam Power Supply System

Starting with the boiler we may note that tubes, drums and other piping parts of watertube boilers are supplied by the manufacturers of the boilers in accordance with their standard practices and that the only piping materials customarily required for fire tube boilers are the tubes and mountings. The tubes should preferably be of charcoal iron on account of its superior resistance to corrosion. When charcoal is used as the fuel for melting and refining the material from which the iron is made, there are no impurities introduced by the fuel into the metal with which it comes in contact; hence the superiority of charcoal iron over iron produced by the use of coke as fuel.

The best steel tubing for boiler tubes is that which has been spellerized. The spellerizing process consists in alternately rolling the piece of metal from which the pipe is made through rolls having regularly shaped projections on them and through smooth faced rolls. This works the surface of the metal in a manner somewhat similar to the puddling of wrought iron and gives to it a uniformly dense texture better adapted to resist local corrosion, such as the pitting of boiler tubes.

As previously stated, copper is the ideal material for pipes where a rapid transmission of heat through the metal is desired. Other considerations operate to prevent its extensive use for boiler tubes in marine boilers, but the United States Steamboat Inspection Service allows copper tubes of small diameter and copper steam drums in the construction of watertube boilers where liquid fuel is used.

Seamless drawn steel is generally specified for main steam pipes of high pressure installations, on account of the previously mentioned reliability of this piping. It is desirable even for pipes of small diameter in the machinery spaces on account of the greater probability of serious results from defective pipes in these spaces. Copper main steam pipes are also good practice and have the advantages previously referred to. By-pass connections are usually of copper and cast iron. It should be remembered that the copper should be ordered hot rolled.

In connection with the use of brazed flanges on copper steam pipes the writer recalls having to deal with a main steam pipe on a steamship which had for the second time given way at a brazed flange. There was perhaps more than the usual amount of vibration to be dealt with. The writer authorized the fitting up of a new section of pipe in a manner to make the flange merely a backing piece and coupling. When the vessel was in port again, some months

later, the writer ascertained that this had remedied the trouble.

Engine receiver piping is generally of copper or cast iron but seamless drawn steel is sometimes used. The copper pipes have brazed metal flanges.

Copper is the most approved material for auxiliary steam pipes where exposed to the weather; but an installation consisting of main deck lines of lap welded iron, galvanized, with copper branches to the individual machinery units and copper expansion bends, affords slight grounds for legitimate unfavorable criticism.

Where the appearance is of sufficient weight to warrant the additional expense, brass pipes, unions and fittings are used for exposed steam and exhaust piping to steering engines, etc., in quarters; and good practice calls for such piping in the pilot house for this reason as well as to have the piping of non-magnetic material.

Steam Power Exhaust System

The principal factors determining the material for main exhaust piping are the sizes and forms of conduit necessitated by the particular installation. In many cases copper is found to be most desirable, in others cast iron, and in others conduits built up of steel plates and angles.

The remarks in the next to the last paragraph of the preceding section dealing with the "Steam Power Supply System" apply also to exhaust piping. Where not exposed to the weather, large sizes of auxiliary exhaust piping are usually of copper, and small sizes of standard iron or steel, preferably the former.

Steam Heating Systems

Steam heating pipes in the pilot house should be of brass on account of the desirability of having them of non-magnetic material.

Steam pipes for heating cargo or bunker oil are of standard black iron unless the pipes are bent to make the grids or formed into coils, in which case they should be extra heavy. The piping is put together in suitable lengths for easy repairs and removal, with joints made by the use of flange unions.

On account of the high heat conductivity of copper, previously referred to, this metal is generally made use of for heating coils where high efficiency or compact installations are factors. Copper is, however, attacked by fuel oil and cannot be used for heating that liquid; it has been found that rigidity is a sufficient factor in some cases to make brass tubing preferable in evaporators.

Power Plant Fresh Water System

Feed pipes for donkey boilers and other small powered installations are sometimes of brass, iron pipe sizes, with brass fittings.

A point to be borne in mind with the use of copper feed water piping is that if there are any low places or pockets not properly drained, which retain the water, it will become acidified and this acidification is a factor in producing boiler corrosion.

Power Plant Salt Water System

Circulating water suction and discharge piping for steam engine installations is preferably of copper on account of the forms required or the vibration to be dealt with. Sections of cast iron may be employed in many cases without evil results.

Condenser tubes are preferably of Admiralty metal. Tinned Muntz metal tubes can be used, but they are inferior to the Admiralty metal tubes and have little or no advantage in first cost.

In some cases condenser tubes are drawn or pierced from a hollow casting in the nature of a short, thick walled tube; in other cases the metal is rolled into slabs from which blanks are cut, after which these blanks are cupped and then drawn or pierced as in the operation first mentioned. The proper condition of the inside of the tube can be more definitely assured and a uniform thickness of the walls can be more readily obtained when the tube is formed from a rolled slab of uniform thickness, both sides of which are exposed to plain view, than when formed from a tubular casting.

The working of the condenser tubes in the process of their manufacture produces internal strains which, unless removed by proper treatment, result in cracks. A sure method to determine if a run of tubes has been properly so treated is to immerse a section of the tubing in a 10 percent solution of mercurous nitrate for fifteen minutes. If there are strains in the metal, cracks will develop which will gradually disintegrate the piece of tubing. If there are no internal strains, the tubing will not be affected at all. Another means that is sometimes specified as a guarantee of freedom from internal strains is based on the great differences in the grain structure of all brass compositions, as the metal passes through the various processes from the original casting to hot and cold working, drawing, annealing, etc. These specifications call for the taking of micrographs, which for Admiralty mixture condenser tubes will show a grain size generally from .015 to .035 millimeter diameter, with .055 millimeter as a maximum size. The method of measuring the size of the grains is that adopted by the American Society for Testing Materials. This specification is also of value in securing tubes having that uniformity of structure which tends to reduce local corrosion and pitting to a minimum.

Bilge and Ballast Systems

Usage makes bilge piping an exception to the general practice of having flanged fittings on pipes over 2 inches in diameter, and the better practice of including the 2-inch pipes in this category, as malleable iron screwed fittings are usually employed. It should be installed in suitable lengths to admit of ready removal for cleaning, repairs, etc., the lengths being connected by flange unions.

Expansion and terminal bends generally are standard lead pipe, which should be 99½ percent pure, with galvanized cast iron flanges; but copper should be used for expansion bends where the exposed piping is run through deep tanks. The writer has had considerable experience with collapsed lead expansion bends in such spaces.

The practice of galvanizing the flanges and ends of piping after the flanges are on is particularly important in the case of the bilge and ballast piping.

In many cases the ballast system has to serve as an oil fuel system, and it should in such cases be laid out to satisfy the requirements of that service.

Sanitary System

In installations where the sanitary main makes connection to the engine water service, the sanitary pump discharge piping should be of brass, iron pipe sizes, with galvanized cast iron flanges and brass fittings.

Drinking Water System

The circulating water coils in the distiller should be heavily tinned.

Plumbing

Butt welded iron or steel pipes are entirely satisfactory for waste pipes of any size.

Lubricating Oil System

Piping may be of brass, copper or seamless drawn annealed steel. The piping on reciprocating engines is preferably of brass.

All screwed piping should be reamed at the ends to

remove burrs and all iron or steel pipes and fittings should be thoroughly cleaned by pickling, and cast iron fittings also cleaned by sand blasting, before being installed.

Flanged joints should be made to all tanks, strainers, filter or separator, pumps, turbines, gear casings and manifolds, and in all cases in brass piping connections. Flanges should be brazed to copper pipes. Sufficient flanged joints and unions should be provided to facilitate inspection and disassembling of piping.

Oil Fuel System

Diesel engine fuel oil piping is preferably of seamless drawn steel tubing properly annealed and thoroughly freed of burrs, dirt, etc.

Copper piping or bends cannot be used for ordinary fuel oil service.

Cargo Oil System

Standard weight piping is in most cases suitable for the whole installation, including the discharge pipes. This does not, however, include the sliding pieces in expansion joints, which should be of extra heavy pipe, turned true.

Refrigerating System

The pipes are lap welded iron, or steel, preferably the former; and to guard against any possible porosity of the welds of the iron pipe it should be double welded. Copper or brass cannot be used with ammonia for piping, fittings or valves. Carbonic acid, on the other hand, is absolutely neutral toward metals.

Some manufacturers of iron and steel pipe have special ammonia pipe for refrigerating service, and this is particularly advisable for iron pipe which is to be bent. For pipes 2 inches and larger special ammonia or redrawn pipes are also advisable.

To insure against leaks in the cooling lines in holds and ships' refrigerated rooms the coils or grids are preferably in continuous electric welded lengths. The screwed couplings at grid terminals should be faced off at both ends and provided with faced locknuts and grommets.

One or more of the classification societies specifies that brine circulating pipes shall not be galvanized on the inside.

Air Piping

Starting and injection air piping for oil engines is in general seamless drawn steel tubing properly annealed and pickled. Copper tubing is used where conditions are such as to require it.

Piping from air pump to air tank and from tank to whistle may be of steel, copper or brass. Steel piping exposed to the weather should be galvanized.

The only satisfactory materials for voice tubing thus far discovered are of the nature of the brass compositions specified in the writer's article on "Non Ferrous Metals and Compositions" in the July issue. Voice tubes made of vulcanized fibre have been tried out, but it was found, as might have been expected, that the voice would not carry in them. The writer understands that the Bureau of Construction and Repair of the Navy Department has been experimenting along other lines with a view toward obtaining substitutes for the standard voice tubing.

General Utility Piping

The table does not cover the great variety of piping that is used on a ship for purposes other than as conduits. Such pipes are mainly of iron or steel, galvanized when exposed to the weather. Brass is used where the magnetic effect of iron or steel has to be avoided, or where desired for the sake of appearance. The most important of such uses are the standard weight galvanized steel pipe used for rails and stanchions, awning supports, hand rails and pipe berths, the standard and extra heavy black steel pipes used for masts and booms, chain pipes and hold stanchions, and the double extra heavy black steel pipes used for long and heavily loaded hold stanchions.

Consumable Stores

The following is a good list of engineer's consumable stores of pipes, fittings and valves, for one ship:

Pipes

	Quantity, in Feet
Brass Pipe, I. P. S., ¼", in 12-foot lengths	24
Iron Pipe, galvanized, extra heavy, ½", ¾", 1", 1¼", 1½", 2", two 12-foot lengths each lap welded where 1¼" and over	144

Pipe Fittings

Malleable Iron Bushings, galvanized, reducing one size, ⅜", ½", ¾", 1", 1¼", 1½", 2", six each size	42
Malleable Iron Elbows, galvanized, 90 degree, ¼", ⅜", ½", ¾", 1", 1¼", 1½", 2", six each	48
Cast Iron Flanges, galvanized, threaded, st'd companion, 1¼", 1½", 2", four each, faced and drilled	12
Wrought Iron Nipples, close and shoulder, ¼", ⅜", ½", ¾", 1", three each size and type	30
1¼", 1½", 2", two each size and type	12
Iron Plugs, galvanized, ¼", ⅜", ½", ¾", 1", six each	30
1¼", 1½", 2", four each	12
Malleable Iron T's, galvanized, ¼", ⅜", ½", ¾", 1", six each	30
1¼", 1½", 2", four each	12
Malleable Iron Unions, ground joint, brass to iron seats, galvanized, ¼", ⅜", ½", ¾", 1", four each	20
1¼", 1½", 2", two each	6

Valves

Brass Pet Cocks, T handles, ¼"	12
Brass Valves, angle and globe, union bonnets, screwed ends, extra heavy, ¼", ⅜", ¾", 1", three each size and type	24
1¼", 1½", 2", two each size and type	12

Table of Requirements for Ships' Piping Systems

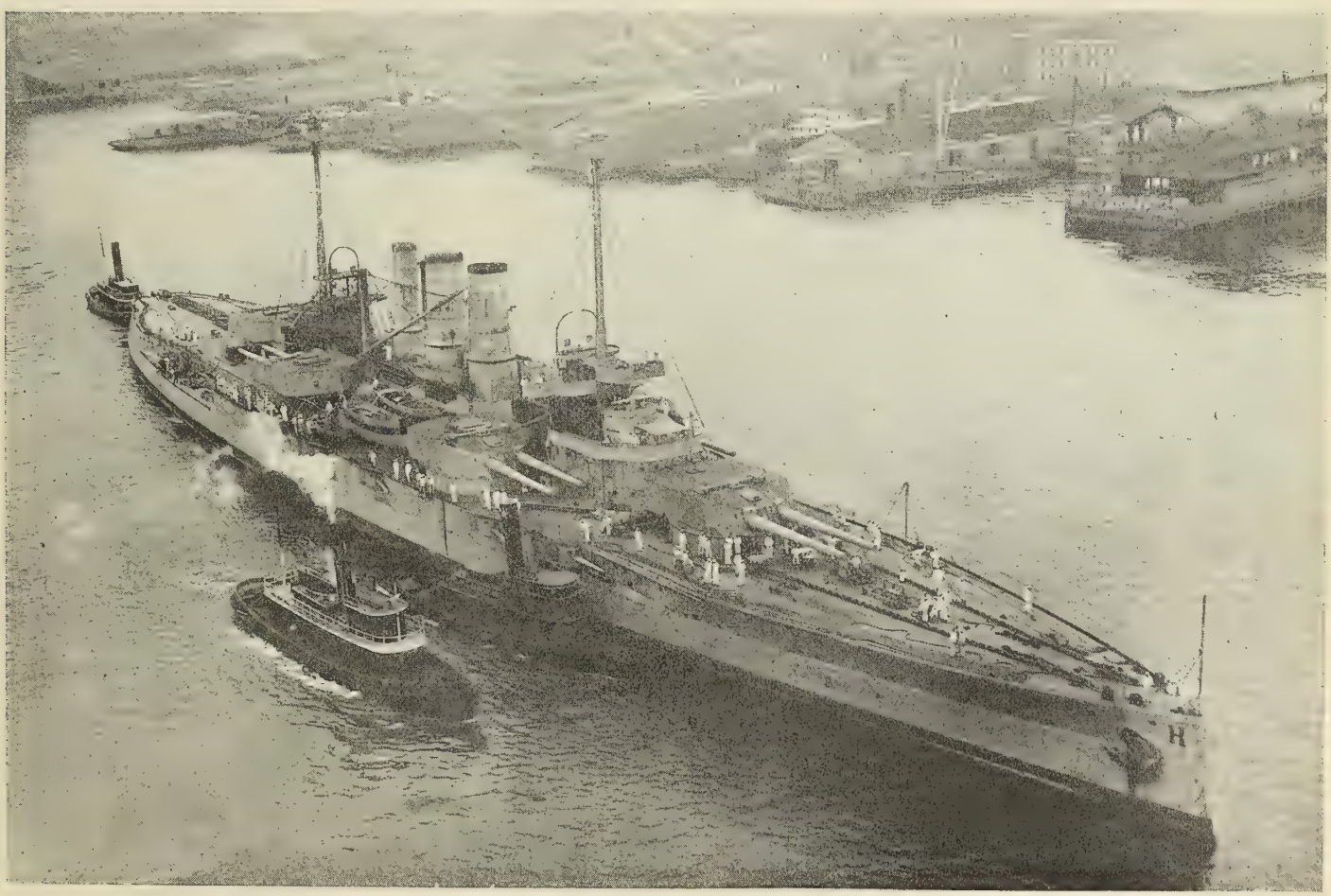
Steam Power Supply System

Service	Pipes	Flanges	Fittings
(1) Boiler tubes	Charcoal Iron		
(2) Boiler mountings	Copper	Brazing Metal	
	X Hvy. Lap Welded Iron.	Forged Steel	Cast Steel or X Hvy. Composition
(3) Main steam	S. D. Steel	Forged Steel	Cast Steel for flanged fittings; Forged Steel for screwed fittings
	Copper	Brazing Metal or Forged Steel	
(4) By-pass and receiver piping	Copper	Brazing Metal	
(5) Aux. steam in machinery spaces—			
(a) Full pressure 2 inches diameter and over	S. D. Steel	Forged Steel	Cast Steel or X Hvy. Comp. or C. I. to suit pressure
	Copper	Brazing Metal	
(b) Full pressure under 2 inches	Lap Welded Steel or Iron, to suit pressure	Forged Steel	Forged Steel or C. I. to suit pressure
(c) Reduced pressure	Std. Lap Welded Iron	Forged Steel	X Hvy. C. I. for flanged fittings, X Hvy. Mall. Iron for screwed fittings
(6) Steam to deck machinery	Copper	Brazing Metal	
	Lap Welded Iron to suit pressure, galvd., with copper branches	Forged Steel galvd. for iron pipes and Brazing Metal for copper pipes	C. I. galvd. to suit pressure for flanged fittings, X Hvy. C. I. galvd. for screw fittings
(7) Steam to whistle	Copper	Brazing Metal	
	S. D. Steel, galvd.	Forged Steel, galvd.	Cast Steel or C. I. to suit pressure, galvd.

Service	Pipes	Flanges	Fittings
(8) Aux. steam other than (5), (6) and (7)	Galvanized where exposed to the weather		
(a) Full pressure 4 inches diameter and over	S. D. Steel	Forged Steel	Cast Steel or C. I. to suit pressure
(b) Full pressure under 4 inches diameter	Lap Welded Steel or Iron to suit pressure	Forged Steel	C. I. to suit pressure for flanged fittings; X Hvy. C. I. for screwed fittings
(c) Reduced pressure	Std. Lap Welded Iron	Forged Steel	X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings
(9) Steam jet	X Hvy. Lap Welded Iron	Forged Steel	Forged Steel
(10) Expansion bends	Copper	Brazing Metal or Forged Steel	
Steam Power Exhaust System			
(11) Escape pipe—			
(a) Where exposed to the weather	Copper	C. I. galvd.	
(b) Branches to safety valves	Copper	C. I.	
	Std. Lap Welded Iron	Forged Steel or C. I.	Std. C. I.
(12) Main exhaust to condenser	Copper	C. I.	
	Cast Iron		
	Riveted Steel	Steel Angles	
(13) Exhaust from deck machinery	Copper	C. I. galvd.	
	Std. Iron, galvd. with copper branches	Forged Steel or C. I. galvd.	C. I. galvd. to suit pressure for flanged fittings; Std. C. I. galvd. for screwed fittings
(14) Aux. exhaust generally	Copper	Forged Steel or C. I.	
	Std. Iron	C. I.	Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings
	Iron pipes, flanges and fittings galvanized where exposed to the weather		
(15) Expansion bends	Copper	Forged Steel	
Steam Smothering System			
(16) Lines to holds, lamp lockers, etc.	Std. Lap Welded Iron, galvd.	Forged Steel, galvd.	C. I. to suit pressure, galvd.
Steam Heating Systems			
(17) Heating accommodations	Std. Iron		X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings
	Copper expansion bends with screwed fittings brazed on		
	Brass		Brass
(18) Heating oil in holds and dbl. bottom—			
(a) Supply and drain pipes	Std. Lap Welded Iron	Forged Steel or C. I.	X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings
(b) Straight pipes in tanks	Std. Lap Welded Iron	(X Hvy. C. I. flange unions)	
(c) Coiled or bent pipes in tanks	X Hvy. Lap Welded Iron		
(19) Heating water tanks, galley sink, etc.	Std. Iron, galvd.		X Hvy. Mall. Iron, galvd.
(20) Galley steam service	Std. Iron, galvd.		X Hvy. Mall. Iron, galvd.
(21) Feed water heater coils	Copper		Special unions
(22) Evaporator coils	Copper or Brass		Special quick detachable joints
(23) Brine heater coils	Copper		Special unions
(24) Pipe in fuel oil heaters	S. D. Steel		
Blow Piping			
(25) Boiler blows	Copper	Brazing Metal or Forged Steel	
(26) Evaporator blow	Copper	Brazing Metal	
	Std. Iron, galvd.	Forged Steel, galvd.	Std. C. I. galvd.
Power Plant Fresh Water System			
(27) Air and condensate pump suction and discharge	Copper	Forged Steel or C. I., galvd.	
(28) Vapor from evaporator	Std. Iron, galvd.		Std. Mall. Iron, galvd.
(29) Feed and general service pumps suction from feed and filter tank, condenser or tanks	Copper	C. I. galvd.	
	Std. Iron, galvd.	C. I. galvd.	Std. Mall. Iron, galvd.
(30) Feed and general service pumps discharge to boiler-feed lines	Copper	Brazing Metal or Forged Steel, galvd.	
	S. D. Steel, galvd. 2 inches and over;	Forged Steel, galvd.	Cast Steel, galvd. or X Hvy. Composition
	X Hvy. Iron, Lap Welded, under 2 inches, galvd.	Forged Steel, galvd.	
(31) Pump reliefs—			
(a) Pressure lines	Copper	Brazing Metal	
(b) Non-pressure lines	Std. Iron, galvd.	C. I. galvd.	Std. Mall. Iron, galvd.
(32) Feed and general service pumps discharge overboard or to feed and filter tank	Copper	C. I. galvd.	
(33) Feed pump discharge to reserve feed tank	Std. Iron, galvd.	C. I. galvd.	Std. C. I. galvd. for flanged fittings; Std. Mall. Iron for screwed fittings
(34) Injector suction from reserve feed tank	Std. Iron, galvd.	C. I. galvd.	Std. Mall. Iron, galvd.
(35) Injector discharge to boiler or aux. feed lines	Copper	Brazing Metal	
(36) Injector discharge to deck or engine room	Std. Iron, galvd.	C. I. galvd.	Std. C. I. galvd.
(37) Boiler circulating pump suction and discharge	Copper	Brazing Metal	
(38) Expansion bends	Copper	Brazing Metal or Forged Steel, galvd.	
Power Plant Salt Water System			
(39) Circulating water suction and discharge piping	Copper	C. I. galvd.	
(40) Condenser tubes	Admiralty Metal		Brass Ferrules
(41) Pump suctions generally	Copper	C. I. galvd.	
(42) Pump discharges overboard and circulating water	Copper	C. I. galvd.	
	Std. Iron, galvd.	Forged Steel or C. I. galvd.	Std. C. I. galvd.
(43) Evaporator feed pump suction	Brass I. P. S.	C. I. galvd.	Std. Brass
(44) Evaporator feed pump discharge to evaporator	Std. Iron, galvd.	C. I. galvd.	Std. Mall. Iron, galvd.
	Brass I. P. S.		Std. Mall. Iron, galvd.
	Std. Iron, galvd.	C. I. galvd.	
(45) Pump reliefs	Std. Iron, galvd.		Std. Mall. Iron, galvd.
Bilge and Ballast Systems			
(46) Bilge mains	Std. Iron, galvd.	(Mall. Iron flange unions, galvd.)	Std. Mall. Iron, galvd.
(47) Ballast mains	Std. Iron, galvd.	C. I. or Forged Steel, galvd.	Std. C. I. galvd.

Service	Pipes	Flanges	Fittings
(48) Expansion bends in deep tanks	Copper	C. I. galvd.	
(49) Expansion and terminal bends generally	Std. Lead	C. I. galvd.	
(50) Pump and syphon suctions in machy. space or holds	Std. Iron, galvd.	C. I. galvd.	Std. C. I. for flanged fittings and Std. Mall. Iron for screwed fittings
(51) Pump and syphon discharges	Std. Iron, galvd.	Forged Steel or C. I. galvd.	
	Copper	C. I. galvd.	
(52) Pump reliefs	Std. Iron, galvd.		Std. Mall. Iron, galvd.
(53) Hand pump suction and overboard discharge	Std. Iron, galvd.	C. I. galvd.	Std. Mall. Iron, galvd.
Fire and Deck Wash System			
(54) Mains	Std. Lap Welded Iron, galvd.	Forged Steel, galvd.	Std. C. I. galvd.
(55) Fire pump suction	Copper	C. I. galvd.	
(56) Fire pump discharge to fire main	Std. Lap Welded Iron, galvd.	Forged Steel, galvd.	Std. C. I. galvd.
(57) Fire pump relief	Std. Iron, galvd.		Std. Mall. Iron, galvd.
(58) Hand pump discharge to fire main	Std. Iron, galvd.	C. I. or Forged Steel, galvd.	Std. C. I. galvd.
Sanitary System			
(59) Mains	Std. Iron, galvd.	C. I. or Forged Steel, galvd.	Std. C. I. galvd.
(60) Sanitary pump suction	Copper	C. I. galvd.	
(61) Sanitary pump discharge to mains	Std. Iron, galvd.	C. I. or Forged Steel, galvd.	Std. C. I. galvd.
(62) Sanitary pump relief	Std. Iron, galvd.		Std. Mall. Iron galvd.
Fresh Water System			
(63) Pressure lines	Std. Iron, galvd.	C. I. or Forged Steel, galvd.	Std. C. I. galvd.
(64) Suction, gravity and drain lines	Std. Iron, galvd.	C. I. galvd.	Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings
(65) F. W. pump suction and relief	Std. Iron, galvd.	C. I. galvd.	Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings
(66) F. W. pump discharge	Std. Iron, galvd.	C. I. or Forged Steel, galvd.	Std. C. I. galvd.
Drinking Water System (Same as fresh water system)			
(67) Distiller coils	Copper		Special unions
Plumbing			
(68) Supply piping where not exposed to view	Std. Iron, galvd.		Std. C. I. galvd.
(69) Deck and other drain pipes where not exposed to view	Std. Iron, galvd.		Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings
(70) Exposed supply piping in petty officers', engineers' and crew's quarters	Std. Steel, galvd.		Std. C. I. galvd.
(71) Exposed drain piping in petty officers', engineers' and crew's quarters	Std. Steel, galvd.		Std. Mall. Iron galvd.
(72) Exposed piping in passengers' and officers' quarters	Some such composition as Benedict nickel		To match pipes
	Brass, nickel plated		To match pipes
(73) Main waste piping	Std. Iron, galvd.	C. I. galvd.	Std. C. I. galvd.
	Lead ¼" thick	C. I. galvd.	
Filling, Air and Sounding Pipes			
(74) Filling pipes	Std. Iron, galvd.	C. I. galvd.	Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings
(75) Air pipes	Std. Iron, galvd.	C. I. galvd.	Std. C. I. return bends above deck; Std. Mall. Iron galvd. generally
(76) Sounding pipes	Std. Iron, galvd.		
(77) Air pump, etc., stand pipes	Std. Iron, galvd.		Std. Mall. Iron, galvd.
Machinery Water Service			
(78) Pump discharge to water service	Brass I. P. S.	C. I. galvd.	Std. Brass
(79) Steam engine piping	Brass I. P. S.		Std. Brass
(80) Oil engine piping			
(a) 2" and over	Std. Iron, galvd.	C. I. or Forged Steel, galvd.	Std. C. I. galvd.
(b) Under 2"	Brass I. P. S.		Std. Brass
(81) Oil engine jacket water piping	Copper	Brazing Metal	
	Brass I. P. S.		Std. Brass
(82) Thrust piping	Brass I. P. S.		Std. Brass
(83) Line shaft bearings	Brass I. P. S.		Std. Brass
	Std. Iron, galvd.		Std. C. I. galvd.
(84) Drain piping to bilge	Std. Iron, galvd.		Std. Mall. Iron galvd.
(85) Cooling coil in thrust bearing	Copper		Brass unions
Lubricating Oil System			
(86) Mains 2" and over	S. D. Steel	Forged Steel	Std. C. I.
(87) Mains under 2"	Brass I. P. S.	(Brass flange unions)	Std. Brass
	Copper	Brazing Metal	
	S. D. Steel		Std. C. I.
(88) Engineers' tank filling pipes	S. D. Steel	C. I.	Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings
(89) Tubes in oil feed boxes	Brass		
(90) Oil cooler tubes	Copper		
Oil Fuel System			
(91) Steam plant suction piping	Std. Steel	Forged Steel or C. I.	Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings
(92) Steam plant pressure piping	X Hvy. Lap Welded Steel.	(X Hvy. C.I. flange unions)	X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings
(93) Expansion bends	Same as piping	Forged Steel or C. I.	
(94) Diesel plant piping from pump to cylinders	Copper	Brazing Metal	
(95) Filling pipes from deck	Std. Steel	Forged Steel or C. I.	Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings
(96) Oil heater tubes	S. D. Steel		

Service	Pipes	Flanges	Fittings
(97) Gasoline piping	Copper		Brass unions
	Brass I. P. S.		Std. Brass
Cargo Oil System			
(98) Filling pipes	Std. Steel	C. I.	Std. C. I.
(99) Discharge mains	Steel to suit pressure	C. I. or Ferrosteel	C. I. to suit pressure
(100) Overboard discharge pipes	Std. Steel	C. I.	Std. C. I.
(101) Expansion bends	Steel to suit pressure	C. I. or Ferrosteel	
Refrigerating System			
(102) Pump discharge to ice machine	Std. Iron, galvd.	C. I. galvd.	Std. C. I. galvd.
(103) Circulating water piping	Std. Iron, galvd.		Std. C. I. galvd.
(104) Ammonia piping and dbl. pipe condenser	X Hvy. Lap Welded Iron, galvd.	Forged Steel special, galvd.	Mall. Cast Steel return bends; Semi-steel flanged fittings; Mall. Iron screwed fittings special
(105) Carbonic acid piping and dbl. pipe condenser	X Hvy. Lap Welded Iron, galvd.	C. I. galvd.	Semi-steel flanged fittings; Mall. Iron screwed fittings special
(106) Ammonia or carbonic acid coils in brine coolers	X Hvy. Lap Welded Iron		Special couplings
(107) Brine piping coils or grids	Std. Lap Welded Iron, galvd.		Special couplings
(108) Brine piping feed and return pipes	X Hvy. Lap Welded Iron, glvd.	C. I. galvd.	Std. C. I. galvd.
(109) Coils in carbonic acid shell type of condenser or cooler	Copper		Special couplings
(110) Scuttle butt coils	X Hvy. Lap Welded Iron, galvd.		Std. C. I. galvd.
Miscellaneous			
(111) Starting and injection air piping for oil engines	S. D. Steel	Forged Steel	Cast Steel
(112) Air piping generally	Std. Lap Welded Steel		C. I. to suit pressure
	Brass I. P. S.		Brass
	Copper		Brass unions
(113) Diesel engine relief piping	Copper	Brazing Metal	
(114) Oil engine exhaust piping	Cast Iron		
	Std. Steel	Forged Steel or C. I.	Std. C. I.
(115) Piping to ash ejector	Std. Iron, galvd.	Forged Steel, galvd.	X Hvy. C. I. galvd.
(116) Ash wetting piping	Std. Iron, galvd.		Std. C. I. galvd.
(117) Engine indicator piping	Brass I. P. S.		Brass
(118) Feed pump gage piping	Brass, I. P. S., to suit pressure		Brass to suit pressure
(119) Gage piping generally	Steel to suit pressure		C. I. or Mall. Iron to suit pressure
(120) Turbine drain piping	Copper	Brazing Metal	
(121) Drain piping generally	Std. Iron, galvd.		Mall. Iron, galvd.
(122) Hydraulic telemotor piping	Copper		Special couplings
(123) Voice tubing	Special Brass		
(124) Fire extinguishing systems other than steam or water	Std. Steel, galvd.	C. I. galvd.	C. I. galvd. special in some sizes
(125) Electric conduits	Special Steel Tubing, galvd.		Special couplings



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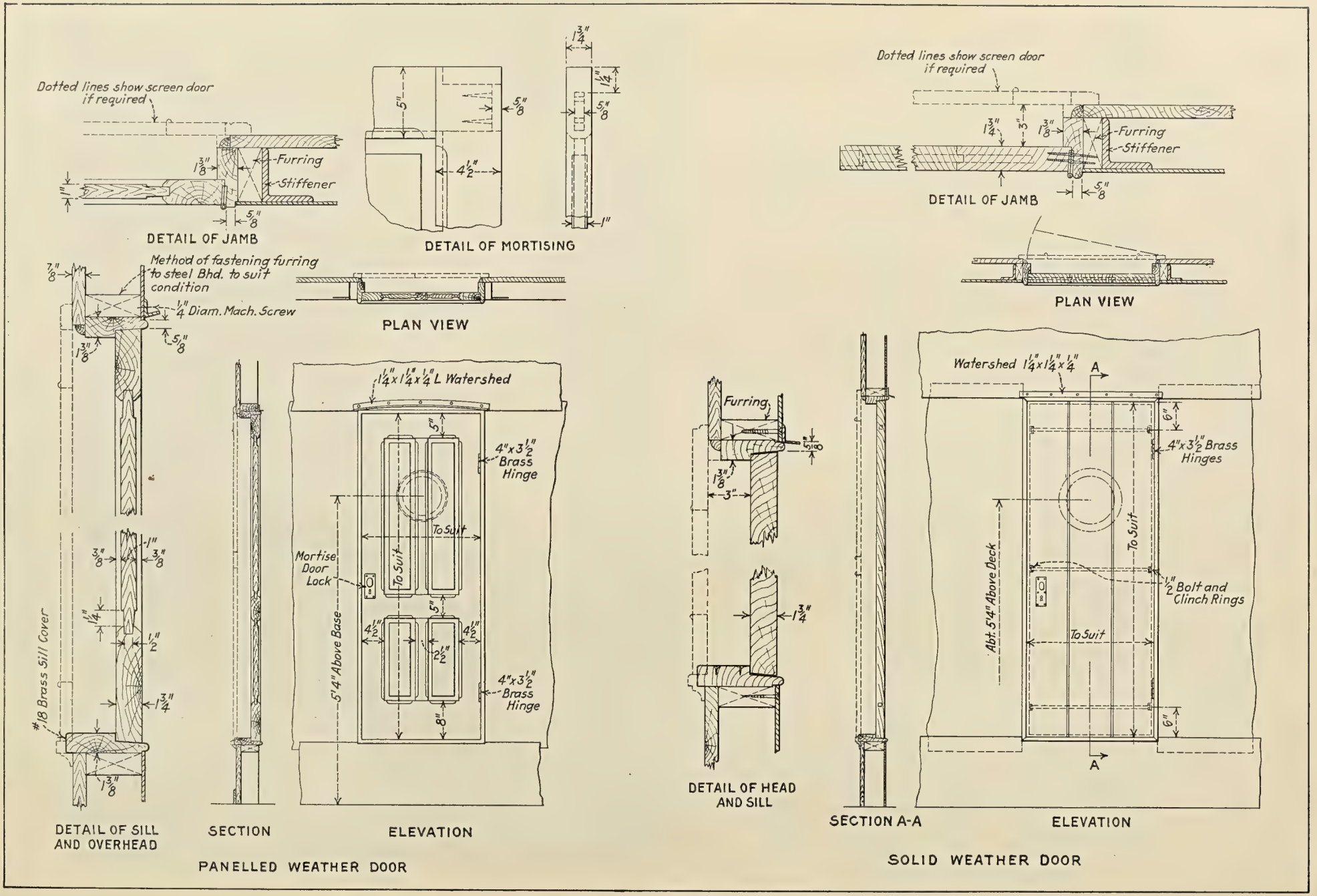
Former German Battleship Ostfriesland Recently Used by the United States Navy and War Departments as a Target for Bombing Tests Off the Virginia Capes

Ship Joiner Plans

Weather Doors



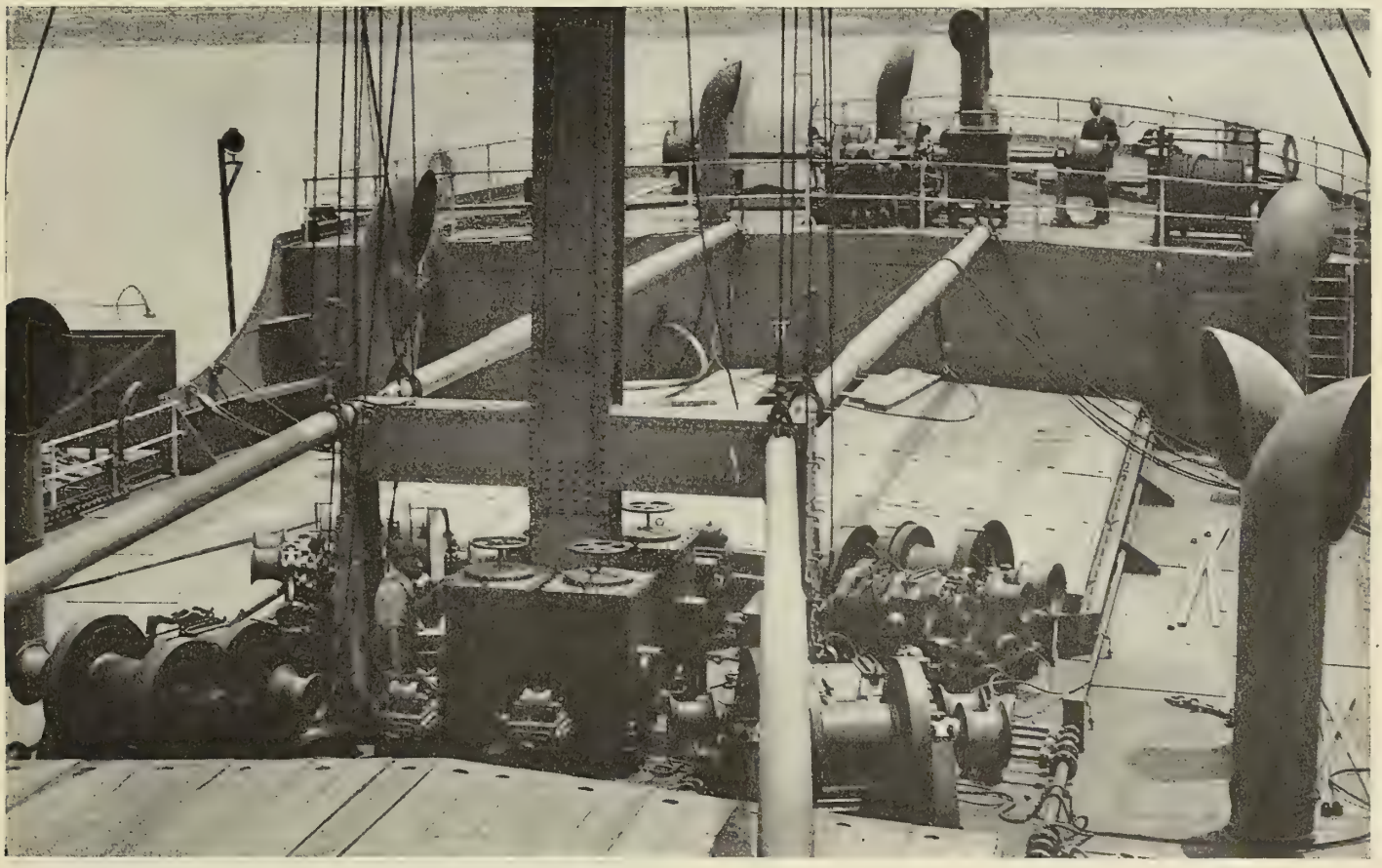
Electric Motors for Merchant Ship Auxiliaries

By Walter E. Thau and William H. Easton*

It would undoubtedly surprise a marine engineer to enter a modern American hotel and discover that the elevators, ventilating fans, vacuum cleaners and other machines scattered through the building were driven by steam engines and that steam pipes ran along the corridors and passed through the rooms. Yet this is the system that is in use on practically every American merchant ship today, and this in spite of the fact that the desirability and reliability of the electric motor have become so well established that there is now no reason why steam engines should continue to be used on shipboard in ways that no one would think of using them on land.

THERE are many reasons why the electric motor should take the place of the steam engine for driving winches, windlasses, capstans, steering gear, pumps, blowers and other auxiliary ship machinery. The motor is more efficient than the steam engine, more compact, more readily applied to a given machine and more easily controlled. It is supplied in types with so wide a variety of speed and power characteristics that exactly the right type can be obtained for driving any given machine. All of its parts that need attention are light, easily accessible and readily repaired or replaced at sea. It can be provided with automatic devices that prevent injury to the machinery because of improper operation. It is safe, clean and quiet in operation.

When steam driven winches are used, thousands of feet of steam and exhaust pipes must run through the ship. These pipes are expensive to install, are usually in the way and frequently cause undesirably high temperatures in holds or living quarters; also exposed portions are liable to freeze up in cold weather. Furthermore, the loss due to condensation and leakage is very large and occurs whenever steam is in the pipes and regardless of whether the engines are being operated or not. But with motor drive, power is transmitted by cables and wires that are easily laid, occupy no valuable space, are unaffected by cold weather and when properly installed cannot be injured in ordinary service. The losses in transmission are small and absolutely cease when the motor stops running.



Electric Winches on the Motorship William Penn

General Requirements of Motors on Board Ship

But the chief reason why motor driven auxiliaries will eventually be used on all ships is that they will in time greatly expedite the handling of the cargo and thus cut down the idle time in port. It is freely conceded that in the present early stages of development the motor driven winch is not greatly superior to the steam driven winch in this respect. But the steam winch is at the end of its development, while the motor driven winch is just at the beginning; and unless the history of electricity on shipboard is vastly different from that of its application in every other field, it will eventually revolutionize our methods of cargo handling and will introduce economies now undreamed of.

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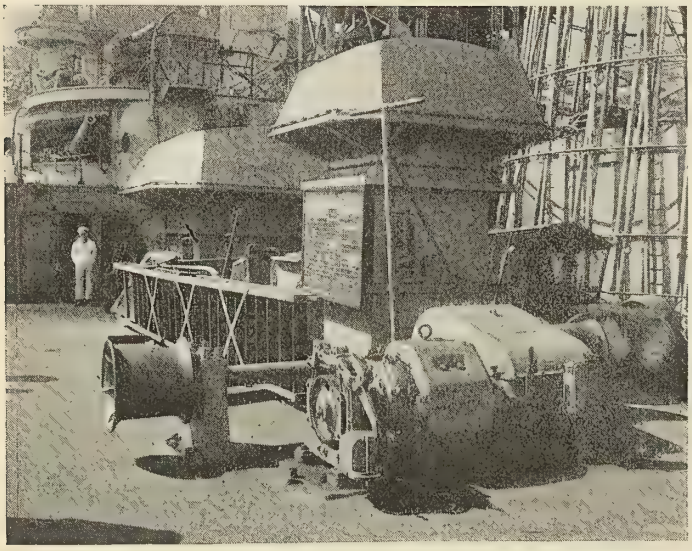
It is, however, impossible to get satisfactory results from a motor on shipboard unless it is specially designed to withstand the peculiar conditions encountered at sea and properly selected to do the particular work it is to be called upon to do. Much trouble has resulted from the attempt to use ordinary land motors on ships and only by careful study and experience have engineers been able to produce motors that are thoroughly reliable for sea service.

All electrical apparatus on shipboard must be sufficiently rugged to withstand the rough handling it is bound to receive. All insulation must be impregnated with water-proofing compounds to prevent injury from salt and moisture, and all light metal parts ordinarily made of steel, such as springs or bolts, must be either made of a non-corroding metal or be protected by a suitable finish. The bearings of motors, generators and other rotating machines must be designed to operate when tilted at a large angle by the roll of the ship. Everything mounted on the deck must be capable of withstanding total submergence for short periods and special care must be taken with deck motors to prevent leakage around the shafts.



Motor-Driven Winch on the U. S. S. Tennessee

Resistors for deck motors present a special problem because they heat under load. The usual practice is to enclose them in water-proof boxes with watertight doors, which are removed when the motor is in use; and these doors are sometimes electrically interlocked with the motor control circuits so that unless they are removed the motor cannot be started. In some applications, however, the resistor boxes have been designed with sufficient radiating capacity to permit operation without ventilation.

Direct Current Versus Alternating Current

Although direct current is being used almost exclusively for ship auxiliaries, alternating current has also found some application, so that it is desirable to consider the relative merits of the two systems.

In Favor of Direct Current:

Generating system simpler and more familiar to the average marine engineer.

Speed of direct current motors is high on light loads and low on heavy loads, whereas the speed of alternating current motors is about the same for all loads. In consequence, direct current provides "livelier" operation.

Loads when being lowered can be effectively controlled by "dynamic" braking when direct current is used, whereas a foot brake is needed with alterating current.

In Favor of Alternating Current:

Alternating current motors are somewhat simpler and more rugged.

They are ideal for constant speed applications, such as pump drives.

The squirrel cage alternating current motor is sparkless in operation.

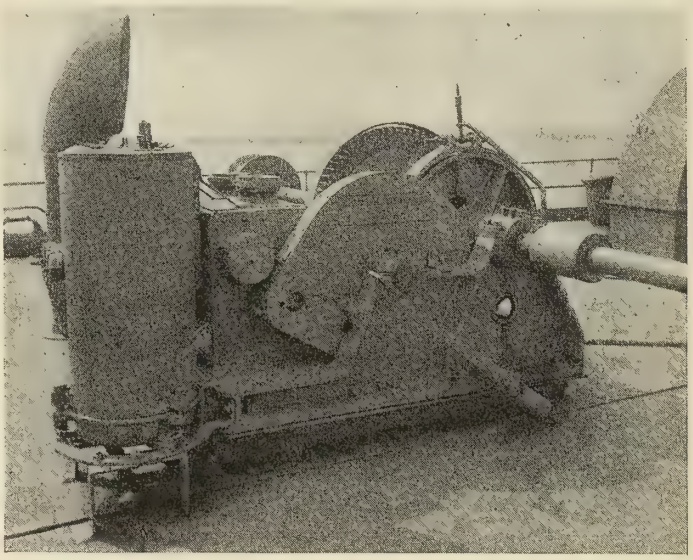
All things being considered, therefore, direct current is preferable for ship auxiliaries, though alternating current may be used for special services, such as on tankers, where the absence of sparking may be desirable. The chief reason why alternating current is used so generally on land is that it can be economically transmitted over long distances, but this advantage does not apply to ship auxiliary service.

It is well to mention in this connection that alternating current is used in the steam-electric system of propelling battleships, because of the ease with which large amounts of power can be transmitted by alternating current at high voltages and because of the inherent suitability of the alternating current generator for high speed turbine drive. But the auxiliary system of a ship is in all cases entirely separate from her propelling system, and standard United States Navy practice is to use direct current for the former, even on ships propelled by alternating current.

Deck Winches

The motor that is best adapted to the requirements of the deck winch is a compound wound, direct current machine, with just enough shunt field to keep the no-load speed within safe limits. This motor develops high torque in starting, operates at slow speed with heavy loads and at high speed with light loads, and can be controlled by dynamic braking when lowering a load.

Dynamic Braking—Inasmuch as "dynamic braking" is not a generally familiar term, a short description of this process may be of interest. It is well known that the same direct current machine can be used either as a motor or a generator, depending upon circumstances. If electric power is supplied to it, its armature will rotate and deliver mechanical power and the machine becomes a motor. If, on the other hand, the armature is turned by means of mechanical power while the fields are excited, the machine delivers power and becomes a generator.



Warping Winch Operated by an Alternating-Current Motor. The Motor Is Enclosed in the Watertight Box. When Operated, the Screw Plugs Are Removed to Provide Ventilation

Consequently, when the load of a motor driven winch is allowed to descend, it turns the motor armature; and if proper connections are made, the motor becomes a generator and delivers current back into the power line or to a resistance load. Now, the speed with which a given weight

can turn the armature of a generator depends upon the amount of current permitted to flow—the greater the flow of current, the greater the magnetic drag on the armature and the lower the speed. Hence, by controlling this current by means of the controller used to control the speed of the motor, the speed of the armature (and therefore the speed of the lowering of the load) can be controlled with extreme nicety. The advantages of this process are (1) the ease of control of the lowering speed and (2) the elimination of the foot brake, with its wear and maintenance expense. In some cases there is actual economy in the method because of the current returned to the line, but this need not be considered on ship installations.

Dynamic braking cannot be used to bring a load to a full stop and hold it suspended, because it is essentially a method of speed control and is operative only when the load is in motion; but in connection with it an electric brake is used which is automatically applied when the current is cut off, and is released when the current is turned on. Dynamic braking is in general and highly successful use in many services, ranging from the control of electric railroad trains to the handling of ladles filled with molten metal in steel mills, and its reliability is beyond question.

The controller generally used in connection with motor driven winches is of the ordinary drum type arranged for reversing and for dynamic braking. A knife switch should be provided in the case so that the controller can be disconnected for inspection or repairs without opening the main switch and stopping all of the other winches. The overload and no-voltage protective devices for the motor should also be located in the controller case, so as to make the entire installation self-contained. If the gypsy head method of hoisting is to be used (in which the gypsy head revolves slowly in one direction and the operator hoists, lowers and controls the speed of the load by tightening or loosening the rope coiled several times around the head) it is advisable to make provision for an especially slow speed.

Where alternating current is used, the winch motor should be of the wound motor type with a drum type controller and a foot brake.

The ordinary deck winch requires a motor of from 15 to 30 horsepower, but as larger motors can be readily used and the speed of handling the cargo thereby increased, the tendency is in that direction. This is an instance of the manner in which the use of electricity improves operation.

Capstan

The electrical equipment for a capstan is in general similar to that of a winch. The controller should be of the reversing type and should provide dynamic braking points for use in passing out a line under strain. If the capstan is of the overhauling type, an electric brake is needed.

A so-called "jamming" resistance is sometimes used in connection with the control of capstan motors. The purpose of this resistance is to permit the motor to maintain its pull even though it is overloaded by the strain on the hawser and the overload protective device has operated. When the jamming resistance is omitted the motor will be completely disconnected from the line under the above circumstances and will relax its pull until the controller is moved to the off position and electrical connection re-established. The jamming resistance, however, permits a little current to flow, thus retaining some tension on the hawser at all times.

As the electrical equipment of a capstan is usually mounted below deck, complete water-proofing is not essential. The capacity of a motor for the average capstan is from 25 to 35 horsepower.

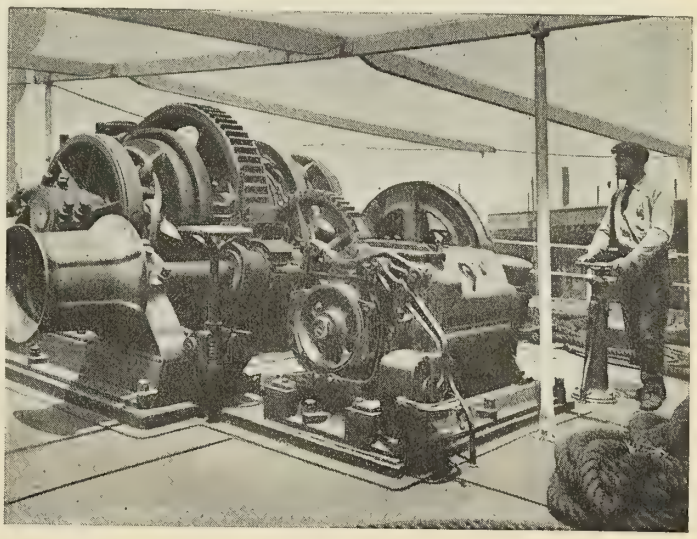
Anchor Windlass

The electrical requirements of anchor windlasses are the same as those of capstans. As the equipment is usually mounted on the deck, it must be perfectly water-proof. Windlass motors range from 30 to 70 horsepower.

Steering Gear

Electric motors are used to operate several different types of steering gear.

Mechanical Screw Gear—In this type the motor is geared to a screw shaft which engages right and left nuts which slide on bars connected to the tiller arm. Starting the motor in one direction turns the rudder, say, to the left,



Anchor Windlass Driven by a Direct-Current Motor of Waterproof Construction

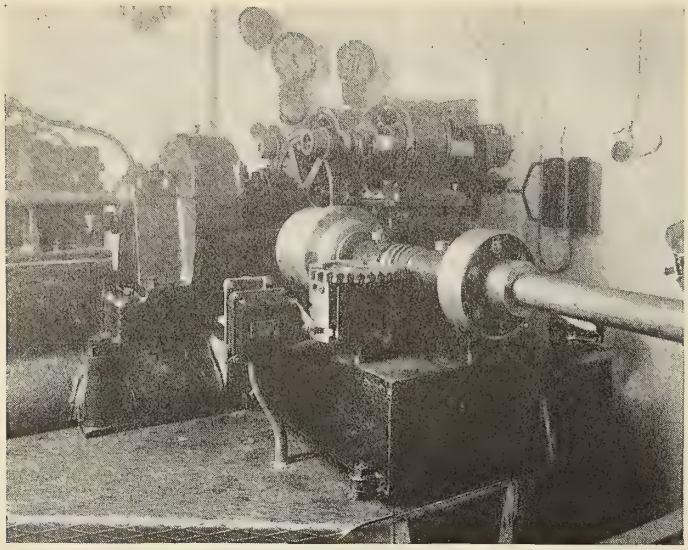
and reversing the motor turns the rudder in the opposite direction.

This service imposes very severe loads on the motor, as there is no special compensation for the rudder resistance in the hard-over positions. The motor must therefore be especially strong and rugged, have ample overload capacity and be suitable for frequent reversals. Ordinarily overload protection is undesirable, for the motor must still be operative even under unusual conditions of overload, as when the rudder fouls with an obstruction or is turned to its extreme limit in either direction and is exposed to unbalanced water pressure. Consequently, the automatic overload devices must operate only under abnormal loads and must then connect the motor across the line through a jamming resistance (or if the motor is overhauled, set an electric brake) so that it will hold its grip on the rudder and automatically return to its proper functioning condition on the removal of the overhead. For small motors the ordinary rheostatic method of control is satisfactory, but for large ones the Ward-Leonard system is preferable.

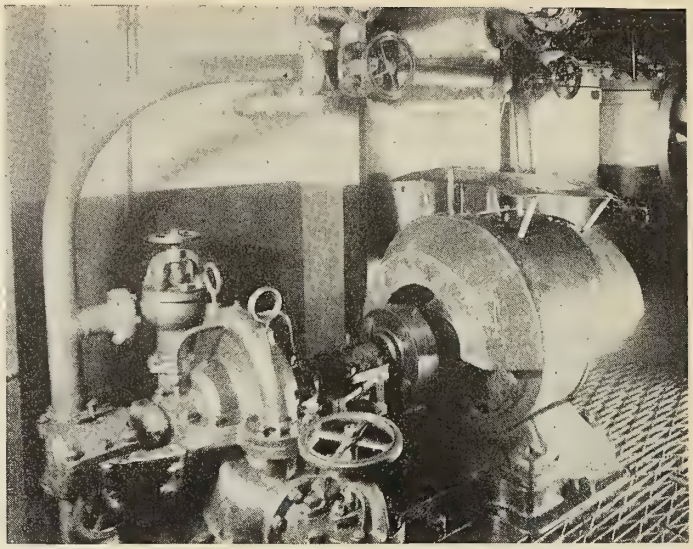
The controller for the steering gear motor must be of the automatic type; that is, the actual motor connections are made by magnetic switches located near the motor, while the operation of these switches is controlled by a small master switch (which can be operated by a wheel or in any other desired manner) in the hands of the helmsman. Master switches can be located at any desired number of stations. Either a follow-up or an indicator system can be used to determine the actual setting of the rudder, though the latter seems to be gaining in popularity.

Limit switches must be employed which stop the motor at the extreme limit of the rudder in either direction, but permit operation in the opposite direction.

Differential Gear—In this system the motor turns a worm shaft and the worms move cranks which are connected to each arm of a double armed tiller, the proportions being so selected that the cranks turn through an angle of 180



Motors Operating Hydraulic Steering Gear Mechanism



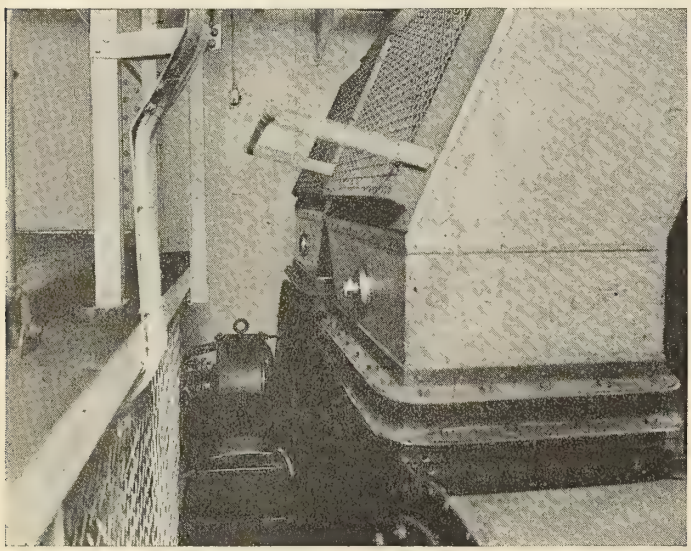
Motor Driven Pump

degrees while the tiller arms turn 70 degrees for the hard-over position. The service is similar to the screw gear, except that the loads on the motor are less severe.

Hydraulic Gear—The hydraulic steering gear has met with great favor in the Navy and is being used more extensively in the merchant marine. The rudder itself is turned by means of two double acting ram cylinders supplied with oil at high pressure from a continuously operated motor driven pump, the flow of the oil to the cylinders being controlled by a "tilting box" operated by a small pilot motor. The operation is as follows:

When the helmsman wishes to turn the rudder he moves a master controller in the desired direction. This starts the pilot motor, which moves the tilting box so as to admit the oil from the pump into the proper ends of the ram cylinders. The pistons then move, turning the rudder in the desired direction, and will continue to move as long as the pilot motor is in operation. An indicator in front of the helmsman shows the motion of the rudder, and when it has turned to the proper angle the helmsman moves his controller to the off position, which stops the pilot motor and also the rudder.

From the standpoint of motor drive, this application is very simple. The pump motor operates continuously in one direction at constant speed and can be either a shunt wound direct current motor or a squirrel cage alternating current motor. The small pilot motor must be suitable for constant reversals.



Motor Driven Ventilating Fan

Limit switches must be used to stop the pilot motor when the rudder reaches the limit of its travel.

The drives of pumps, ventilating fans, refrigerating machines and other auxiliary machinery on a ship do not differ materially from similar applications on land and standard motors and controllers (with special marine protection) are used for these applications.

The capacity of the auxiliary generating equipment for a ship depends upon the amount of power she will need when loading or unloading in port, as her sea load will be from 35 to 50 percent of this amount, and her load when entering port will be from 60 to 75 percent.

It would, of course, be possible to install a single generator to take care of this entire load, but actually it must be split up among at least two, and preferably three, duplicate units, while good practice calls for at least one additional spare unit. The reasons for this sub-division are: (1) the safety and the efficiency of the ship would be endangered, if additional spare units were not available for instant use in case of the failure of a unit; and (2) the most economical operation can be obtained by proportioning the number of generating units to the load requirements, thus loading the units in operation at or near their full capacity. All of the units should be exactly alike to simplify maintenance and the supply of spare parts.

Generators—Standard generators, of either the direct current or alternating current type, can be used in this service, provided they are protected against moisture and have bearings that can be tilted at an angle. As the transmission distances are short, no compensation for line drop is necessary and direct current machines can be flat compounded. The generators must be arranged for parallel operation and should be selected with liberal overload capacities.

Prime Movers—On steamships reciprocating engines have so far been generally employed for driving the generators, but turbines are now being preferred because of their lighter weight, smaller dimensions, quieter and cleaner operation and higher operating efficiency.

On motorships oil engines are preferable; and since the operation of alternating current generators in parallel by means of oil engines under the conditions encountered on board ships is not entirely satisfactory, only the direct current system should be employed.

Switchboards—The switching equipment for a ship's power plant does not differ materially from that used on land. It is believed, however, that it is especially good practice to use safety enclosed switches, dead-front switchboards, safety panels and other protected devices, which prevent accidental contact with live parts.

Problem of the Hull and Its Screw Propeller V*

Formulas for the Design of the Propeller—Determination of the Design Point — Ratio of Pitch to Diameter

By Rear-Admiral C. W. Dyson, U. S. N.

THE data supplied the designer in order to determine upon the proper propeller to meet any given set of conditions usually come in one of three forms:

1. Required speed, effective horsepower for this speed, and revolutions of propeller desired at this speed.

2. Effective horsepower curve for the ship, designed power of the engines and revolutions of the propeller at this power.

3. Designed power of the engines and revolutions of the propeller, desired speed of vessel.

With each of these are supplied the hull characteristics of the vessel, together with distance between center of propeller hub and skin of ship or between center of hub and limiting dimensions of the propeller well.

When data of form 1 are given the problem consists in determining not only the characteristics of the propeller but also the engine power necessary to drive the vessel at the required speed.

When data of form 2 are given, in addition to the characteristics of the propeller, the maximum speed of vessel which can be obtained with the designed power of the engines is also determined.

Finally, with form 3 data, the propeller designer is in the hands of the naval architect. So far as the designer of the propeller is concerned, the ship may or may not make the desired speed with the designed power at the designed condition of load. He can only feel confident that she will make it at some load condition. To call on him for a guaranteed performance is, to say the least, an absurdity and to blame him for failure is to carry injustice to the extreme.

In selecting the point upon which to base the design Fig. 8 is used and the preliminary point or points taken will depend upon the type of vessel and the derived basic slip of the vessel. The point or points taken should be at sufficient height above the cavitation curve for the basic slip and the value of K as to insure that for any probable increase in resistance of the hull, due to deep loading, foul bottom or ordinary heavy weather conditions, the value of $v \div V$ will not be reduced to such an extent as to lower the performance point below the curve of cavitation.

Ratio of Pitch to Diameter

The limitation for this ratio is not definitely known but for safety it is recommended that a lower value of about .75 be taken as a limit, although conditions may arise where it will be found necessary to go even lower than this value. The curve E, Fig. 8 (see May issue), need not be adhered to rigidly as the upper limit of design but this limit and the maximum limit of $\frac{\text{e. h. p.}}{\text{E. H. P.}}$ used for the adopted point of design should be regulated by the values of $P \div D$ and of P. A. $\div$ D. A. which are obtained in the calculation. It is undesirable to use a basic value of P. A. $\div$ D. A. of less than approximately .23 on account of the bluntness of blade sections which result with the smaller values.

Formulas for Design

FORM I: DATA AS PER I

(1) v (required speed).....	v	v	v	(Const.)
(2) $n \times$ e. h. p. (required effective horsepower)	$n \times$ e. h. p.	$n \times$ e. h. p.	$n \times$ e. h. p.	(Const.)
(3) n (number of propellers).	n	n	n	(Const.)
(4) e. h. p. (on 1 propeller)..	e. h. p.	e. h. p.	e. h. p.	(Const.)
(5) e. h. p. $\div$ E. H. P. (load fractions used)	Val. 1	Val. 2	Val. 3	(Variable)
(6) $v \div V$ (speed fraction for values of (5)).....	1	2	3	(Variable)
(7) E. H. P. = (4) $\div$ (5)..	1	2	3	(Variable)
(8) V = (1) $\div$ (6).....	1	2	3	(Variable)
(9) S (basic slip from hull characteristics)	S	S	S	(Constant)
(10) D (proposed diameter)...	D	D	D	(Constant)
(11) E. $T_p \times$ (P. A. $\div$ D. A.)	1	2	3	(Variable)
E. $T_p \times$ (P. A. $\div$ D. A.) =	$\begin{cases} (2.88 \times \text{E. H. P.}) \div (D^2 \times V) \text{ for 3-bladed propellers.} \\ (2.491 \times \text{E. H. P.}) \div (D^2 \times V) \text{ for 4-bladed propellers.} \\ (3.84 \times \text{E. H. P.}) \div (D^2 \times V) \text{ for 2-bladed propellers.} \end{cases}$			
(12) P. A. $\div$ D. A. (for (11) Fig. 9)	1	2	3	(Variable)
(12) = projected area ratio if the propeller is 3-bladed = basic.				
(13) 4/3 (P. A. $\div$ D. A.) = (total projected area ratio for 4 blades).....	1	2	3	(Variable)
(14) 2/3 (P. A. $\div$ D. A.) = (total projected area ratio for 2 blades).....	1	2	3	(Variable)
(15) P. C. (propulsive coefficient for (12), (13) or (14))	1	2	3	(Variable)
(16) I. H. P. = E. H. P. $\div$ P. C. = basic I. H. P..	1	2	3	(Variable)
(17) S. H. P. = .92 $\times$ I. H. P. = basic shaft horsepower	1	2	3	(Variable)
(18) Z_p = Power factor for $\frac{\text{e. h. p.}}{\text{E. H. P.}}$ (Fig. 7).....	1	2	3	(Variable)
(19) K = Power augment (Fig. 4)	K	K	K	(Constant)
(20) I. H. P.a or S. H. P.a = (I. H. P. $\div$ $10Z_p$ or S. H. P. $\div$ $10Z_p$) $\times$ K = Est. of power.....	1	2	3	(Variable)
(21) T. S. = Tip speed for (12)	1	2	3	(Variable)
(22) $1 - S = 1 - (9)$.....	$(1 - S)$	$(1 - S)$	$(1 - S)$	(Constant)
(23) P = (πD $\times$ V $\times$ 101.33) $\div$ (T. S. $\times$ $(1 - S)$) = Pitch	1	2	3	(Variable)
(24) Z_s = Speed factor for $\frac{v}{V}$, Fig. 7, Curve 1.....	1	2	3	(Variable)
(25) s = ($S \times$ I. H. P.a $\times$ $10Z_s$) $\div$ I. H. P. = ($S \times$ S. H. P.a $\times$ $10Z_s$) $\div$ S. H. P. = apparent slip	1	2	3	(Variable)
(26) R_a = ($v \times$ 101.33) $\div$ (P $\times$ $(1 - s)$) = estimated revolutions	1	2	3	(Variable)

Should the revolutions obtained be less than those desired and a good ratio of $P \div D$ exist, the revolutions may be increased in two ways, both of which produce a reduction in efficiency.

(a) Retain original diameter and increase values of $v \div V$.

(b) Reduce the diameter and retain the original values of $v \div V$.

By the (a) process the projected area ratio will be increased and the values of $P \div D$ and of s will be reduced but the safety distance above cavitation will increase.

By the (b) process the values of the projected area ratios will be increased, $P \div D$ will remain constant and s will be increased while the safety remains as originally.

(c) A third method may also be used; that is, the rise above the original point may be made by keeping the effective thrust constant. This will maintain constant projected area ratios, reduced efficiency, decrease in s and increase in revolutions but the reduction in efficiency will not be so great as in (a).

Should the revolutions obtained be higher than those desired follow the opposite course to (a), (b) or (c) and the effects will be opposite. Care must be taken to preserve suffi-

*Paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1920.

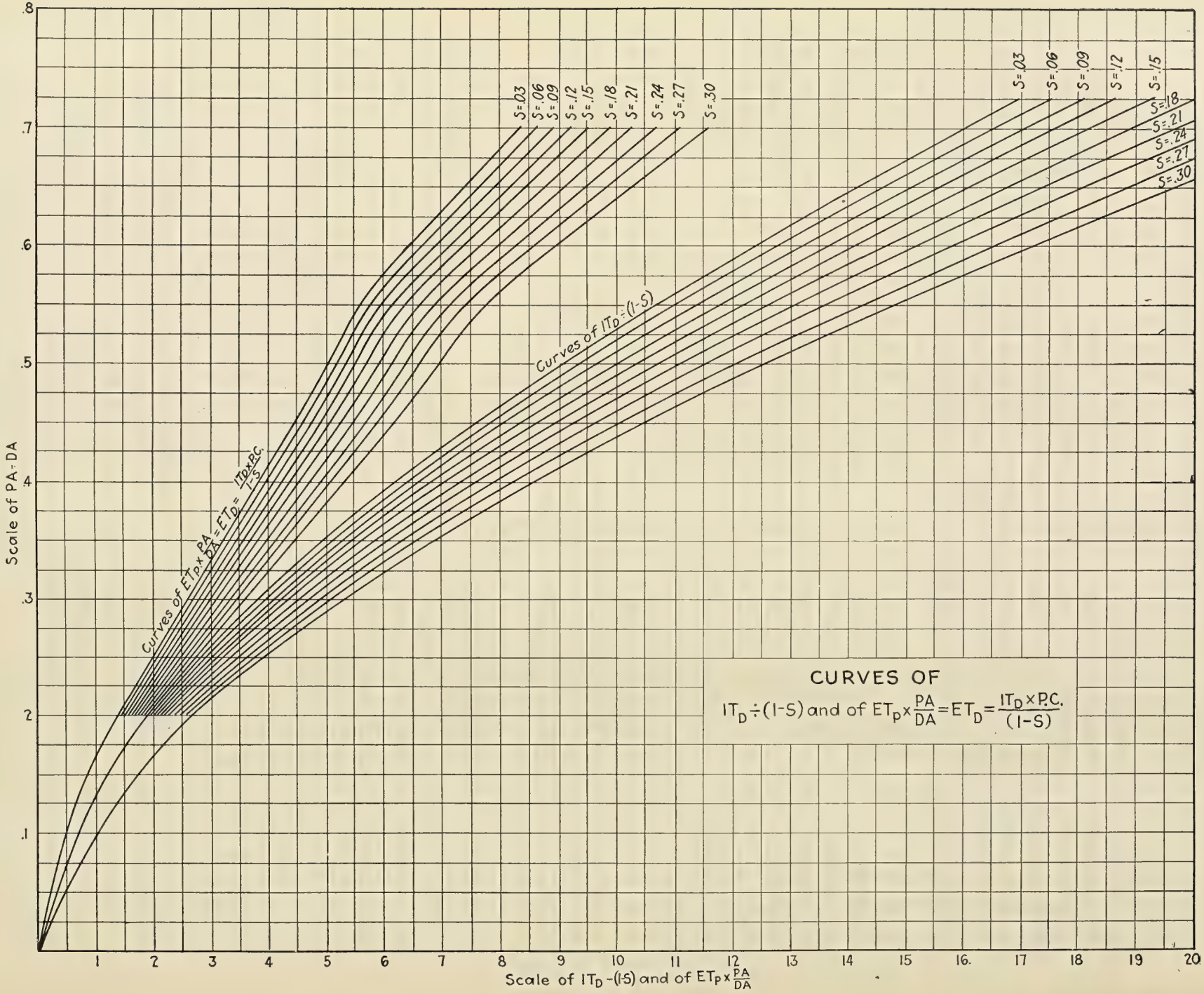

Scale of PA-DA
.8
.7
.6
.5
.4
.3
.2
.1
S=.03
S=.06
S=.09
S=.12
S=.15
S=.18
S=.21
S=.24
S=.27
S=.30
Curves of $IT_D \div (1-S)$
Curves of $ET_p \times \frac{PA}{DA} = ET_D = \frac{IT_D \times P.C.}{1-S}$
CURVES OF
$IT_D \div (1-S)$ and of $ET_p \times \frac{PA}{DA} = ET_D = \frac{IT_D \times P.C.}{(1-S)}$
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16. 17 18 19 20
Scale of $IT_D - (1-S)$ and of $ET_p \times \frac{PA}{DA}$

Fig. 9

cient safety clearance above the cavitation curve and to do this it may be necessary to hold the $\frac{v}{V}$ constant and use a lower value of $\frac{\text{e. h. p.}}{\text{E. H. P.}}$

FORM 2: DATA AS PER 2

(1) v (covering range of expected speed)	1	2	3	(Variable)
(2) $n \times$ e. h. p. (total effective H. P. for v's)	1	2	3	(Variable)
(3) n = number of propellers	n	n	n	(Constant)
(4) e. h. p. = effective H. P. on one propeller	1	2	3	(Variable)

Proceed as in form 1. Should the revolutions for the designed power be greater or less than those desired, proceed as in (*a*), (*b*) or (*c*).

The expected speed will be that corresponding to the designed power and revolutions as determined by the calculations.

FORM 3: DATA AS PER 3

(1) n S. H. P.d (designed shaft horsepower)	n S. H. P.d	n S. H. P.d	n S. H. P.d	(Const.)
(2) n I. H. P. (designed I. H. P.) = n S. H. P.d $\div$ .92	n I. H. P.d	n I. H. P.d	n I. H. P.d	(Const.)
(3) n (number of propellers)	n	n	n	(Const.)
(4) I. H. P.d (I. H. P. on one propeller)	I. H. P.d	I. H. P.d	I. H. P.d	(Const.)
(5) v (expected speed)	v	v	v	(Const.)
(6) e. h. p. $\div$ E. H. P. (assumed load fractions)	1	2	3	(Variable)
(7) $v \div V$ = Speed fractions at assumed points on (6)	1	2	3	(Variable)
(8) D (assumed diameter)	D	D	D	(Constant)
(9) S (basic slip for hull conditions)	S	S	S	(Constant)
(10) $V = v \div (v \div V) =$ basic speed	1	1	1	(Variable)
(11) K = Power augment	K	K	K	(Constant)
(12) Z_p = Power factor for $\frac{\text{e. h. p.}}{\text{E. H. P.}}$ (Fig. 7)	1	2	3	(Variable)
(13) I. H. P. = I. H. P.d $\times$ $10Z_p \div K$ = basic power	1	2	3	(Variable)
(14) I. T.d $\div (1 - S)$	1	2	3	(Variable)

I. T. $\div (1 - S) =$ { (2.88 × I. H. P.) $\div (D^2 \times V)$ for 3-bladed propellers. (2.491 × I. H. P.) $\div (D^2 \times V)$ for 4-bladed propellers. (3.84 × I. H. P.) $\div (D^2 \times V)$ for 2-bladed propellers.

(15) P. A. $\div$ D. A. = Projected area ratio for (14) Fig. 9 — 1 2 3 (Variable)

(15) = Projected area ratio of the propeller if 3-bladed = Basic.

(16) 4/3 (P. A. $\div$ D. A.) = Total projected area ratio for 4-bladed.

(17) 2/3 (P. A. $\div$ D. A.) = Total projected area ratio for 2-bladed.

(18) P. C. = Propulsive coefficient for (15), (16), or (17)	1	2	3	(Variable)
(19) E. H. P. = I. H. P. $\times$ P. C. = Basic effective horsepower	1	2	3	(Variable)
(20) e. h. p. = E. H. P. $\times$ (e. h. p. $\div$ E. H. P.) = effective horsepower delivered	1	2	3	(Variable)
(21) p. c. = Propulsive coefficient expected = { n $\times$ (20) $\div$ (1) or (2) }	1	2	3	(Variable)
(22) T. S. = Tip speed for (15), Fig. 5	1	2	3	(Variable)
(23) $1 - S = 1 -$ (9)	$(1 - S)$	$(1 - S)$	$(1 - S)$	(Constant)
(24) $P = (\pi D \times V \times 101.33) \div$ (T. S. $\times (1 - S)$)	1	2	3	(Variable)
(25) Z_s = Speed factor for $\frac{v}{V}$, Fig. 7, curve 1	1	2	3	(Variable)
(26) $s = (S \times$ (I. H. P.d or S. H. P.d) $\times$ $10Z_s) \div$ (I. H. P. or S. H. P.)	1	2	3	(Variable)
(27) $R_d = (v \times 101.33) \div (P \times (1 - s))$	1	2	3	(Variable)

If proper revolutions are not obtained, proceed as before.

Attention should be called to one danger that is incurred where I. H. P.d or S. H. P.d are used in obtaining the characteristics of a propeller. This danger is produced by an incorrect estimate of K. Should the K used be too small the propeller obtained will be too large while the efficiency promised will be greater than will be realized. The propeller will, however, be lifted higher in the safety zone than expected. Should K be too large the opposite results occur.

In many problems that arise the permissible diameter of propeller will be too small to reduce the revolutions under standard conditions of design to so low a number as the problem requires. In such cases it becomes necessary to resort to what may be called a method of reduced diameter.

Propellers of Reduced Diameter

There are two of these methods, as follows:

1. Method by changing form of blades to fantail.
2. Method by changing form of blades to broad tip.

By the first method, the propeller, by using the actual effective horsepower to be delivered or a modification of the propelling I. H. P.d or S. H. P.d is designed for a larger diameter and lower number of revolutions than specified. The tips are then cut off the blades and the original projected areas retained by widening the blade tips beyond the centers of pressure by an amount of area equal to that cut off from the tips. This method produces higher pitches, considerably lower revolutions and slightly less efficiency than the standard method of design and must be used when the reduction in revolutions is considerable.

By the second method the propeller is designed for a greater diameter than can be carried using a higher effective or engine power than required for the ship. The tips are then cut off the blades reducing them to the diameter allowed.

This method maintains practically constant efficiency with the basic full diameter propeller with a higher pitch and lower revolutions than would be obtained by the regular method of design but the revolutions are not decreased to the same extent as by the first method of reduction.

Formulas for Reduced Diameter

FORM 1: FANTAIL

(1) D = Diameter possible	D	D	D	(Constant)
(2) D_1 = Assumed diameter > D	1	2	3	(Variable)
(3) $D_1 \div D$	1	2	3	(Variable)
(4) $(D_1 \div D)^{1/2}$	1	2	3	(Variable)
(5) e. h. p. (effective horsepower on one propeller)	e. h. p.	e. h. p.	e. h. p.	(Constant)

Now proceed as in preceding methods, using D_1, until I. H. P.d^1 or S. H. P.d^1 have been obtained. The actual corrected power will then be

$$\text{I. H. P.}_d \text{ (corrected)} = \text{I. H. P.}_d{}^1 \times \frac{D_1}{D}$$

Use D_1 in obtaining the pitch and then proceeding to the apparent slip use the uncorrected value of I. H. P.d^1 or S. H. P.d^1. Use this slip in obtaining the revolutions for the propeller with diameter D_1 then corrected revolutions equal

$$R_d \text{ (corrected)} = R_d{}^1 \times \left(\frac{D_1}{D}\right)^{\frac{1}{2}}$$

When the basis of design is engine power instead of effective the power must be reduced as follows:

$$\text{I. H. P.}_d{}^1 = \text{engine power} \times \left(\frac{D}{D_1}\right)$$

FORM 2: BROAD TIP

(1) D = Diameter possible	D	D	D	(Constant)
(2) D_1 = Assumed diameter > D	1	2	3	(Variable)
(3) $(D_1 \div D)^2$	1	2	3	(Variable)
(4) $(D_1 \div D)^{1/4}$	1	2	3	(Variable)
(5) e. h. p.$_1$ = e. h. p. (actual $\times$ $(D_1 \div D)^2$)	1	2	3	(Variable)

Use D_1 and e. h. p.$_1$ in designing the full diameter propeller. Calling the speed of ship v, then by the regular method of design, using e. h. p.$_1$ for v, the derived power for the full diameter propeller required for the speed v will be I. H. P.$_{d_1}$ and the actual power required for the reduced diameter propeller will be

$$\text{I. H. P.}_d = \text{I. H. P.}_{d_1} \times \left(\frac{D_1}{D}\right)^2$$

The actual revolutions will be

$$R_d = R_{d1} \text{ (estimated revolutions, full diameter)} \times \left(\frac{D_1}{D}\right)^{\frac{1}{4}}$$

Where the engine power forms the basis of the design this power should be multiplied by $\left(\frac{D_1}{D}\right)^2$ for the power to use in obtaining the full diameter screw.

Such broad tip propellers have one peculiarity, so far as can be ascertained, and that is encountered when they are used on submarines having slips of the first order:

When running on the surface the revolution correcter is $\left(\frac{D_1}{D}\right)^{\frac{1}{4}}$ as given above. When running submerged and plotting below curve B, Fig. 8, this factor changes to $\left(\frac{D_1}{D}\right)^{\frac{1}{2}}$

Conclusion

The paper as submitted embraces the results of many years of study by the author so far as what may be considered orthodox forms of hulls with orthodox propeller conditions are concerned. The questions of small diameter propellers carried as deeply as possible in the cases of deep draft vessels, propellers for double enders, propellers for tunnel boats, etc., have not been touched. All of these various problems require special study to determine the particular values of K and of S to use in the designs of the propellers.

The problems involved in so recording the results and conclusions of years of study and experience in such a manner that all may readily make use of them have not been easy ones and even in the final results as submitted there are ranges of indefiniteness which the author, due to lack of reliable data, has no means of clearing up as they should be cleared up.

Several of these regions of indefiniteness are the determination of the ranges of fineness of hulls covering the transition from hulls of type 2 to those of type 1 and from those of type 1 to those of type 3, also the slight range of speed fraction values at the curve B, Fig. 8, in which the apparent slips pass from slips of the first order to those of the second.

Commander McEntee, with his hull models driven by model propellers, has provided a means by which some of the problems may be solved and by which, when propellers are designed in the safety zones, the true values of K may be obtained, but it is stated that this method of Commander McEntee's is of no use in the cavitation ranges although the author does not agree with this statement where dispersal of the thrust column occurs.

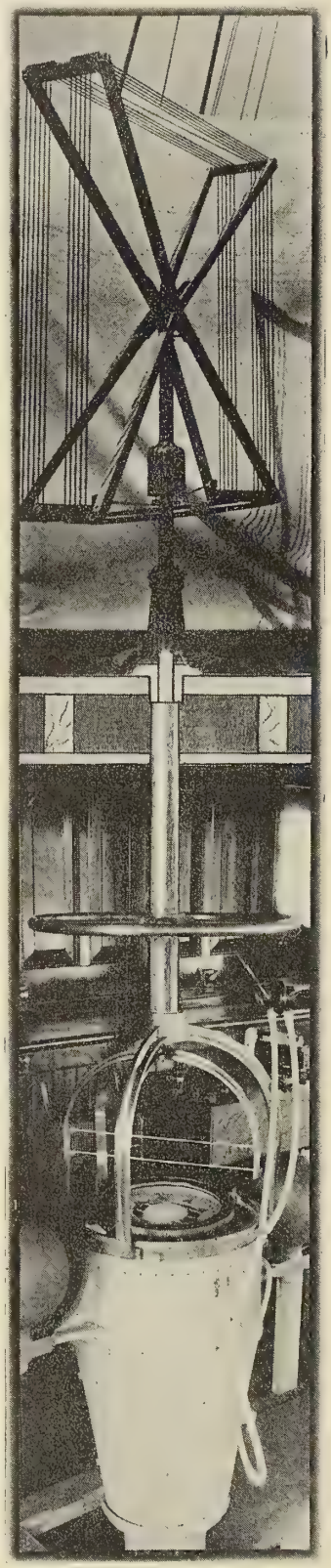
Problems of the Future

For a complete solution and accurate representation of the phenomena that occur it is necessary to look to the future, trusting that it will bring with it a vast amount of performance data of sufficient value that it can be used with confidence and the complete life history of the hull with its propeller plotted in such a manner as to provide an infallible guide to success in the solution of later problems regarding the propulsion of ships.

It is hoped that the material which has been opened up for inspection will thoroughly impress the student with the fact that the hull with its propeller must be treated in conjunction in the solution of the problem of propulsion. To treat of the propeller without its accompanying hull is to lose time in the ultimate complete solution of the problem involved. The perfect solution of the "Problem of the Hull and its Screw Propeller" rests in the hands of the shipowners, naval architects and marine engineers and without their hearty and intelligent cooperation in the future the problem may never be entirely solved.

The Radio Compass on Ship Board

THE method of radio direction finding, or radio fog signals, which has been developed by the United States Lighthouse Service and the Bureau of Standards, is based on the peculiar properties of the so-called "coil aerial" when used for the reception of radio signals. This coil consists of about 10 turns of insulated copper wire upon a rotatable frame approximately four feet square. When the plane of the coil is parallel to the direction from which a radio signal emanates, the intensity of the signal received will be a maximum. As the coil is revolved, the intensity of the signal diminishes until a minimum is reached when the plane of the coil comes to a position at right angles to the line of direction from the signal. This minimum, which is well defined, may be determined with sufficient accuracy for navigational purposes, and is used in taking radio bearings.



Radio Compass Installation

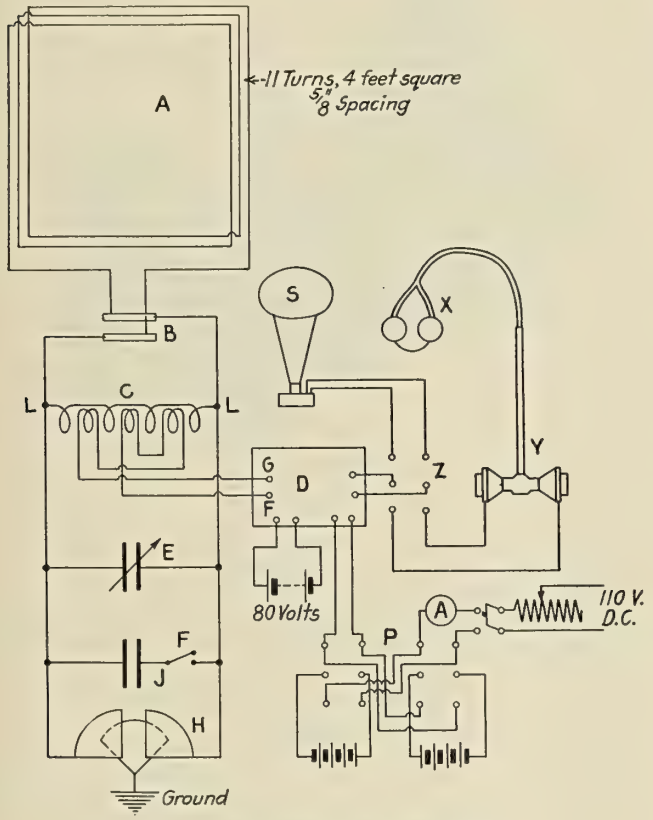
The coil aerial mounted upon a vertical spindle provided with a pointer, and a graduated circle below the pointer for determining the position of the coil with respect to a known direction, constitutes what is known as the radio compass or radio direction finder. This apparatus, and the necessary radio receiving device, are installed on the vessel, preferably in a position easily accessible to the navigator.

In the installations which have been made on lighthouse tenders, the coil is mounted on the roof of the pilot house. The spindle extends through the roof and is provided with a hand wheel for rotating the coil. The lower end of the spindle terminates directly above the center of a standard ship's binnacle and carries a pointer so arranged that the position of the coil may be read directly upon the compass card, thus giving the magnetic bearing of the radio signal station at a glance, when the minimum point is reached.

After the radio direction finder has been installed on the vessel, a careful calibration is necessary to eliminate errors caused by distortion of the radio signal by the vessel itself. Simultaneous radio bearings and sight shots with an azimuth circle are taken on a con-

venient radio signal station at intervals of approximately five degrees while the vessel is swung several times in a complete circle. The deviation of the radio bearing from the true bearing is thus obtained for all positions of the coil with respect to the ship's axis. These corrections are then recorded on a circular frame of metal attached to the top of the binnacle and surrounding the magnetic compass, and applied to all subsequent readings of the radio direction finder.

The ordinary telephone receivers, if used by the operator of the direction finder, by reason of their close proximity to the magnetic compass, would cause a deflection of the needle. This difficulty is overcome by installing a special receiver at some distance from the magnetic compass, and conducting



Circuit for Radio Direction Finder

the sound therefrom to the operator by means of rubber tubing.

In order to obtain satisfactory results from radio compass navigation, it is essential that the compass be properly constructed, installed and calibrated, and that only receivers and amplifiers of the special type required be used in connection therewith. Until commercial apparatus of this nature has been standardized and tested, care should be exercised to avoid the installation of compasses of improper design. The Bureau of Standards is now preparing a standard specification for this purpose.

Precaution must be taken by the navigator in applying bearings taken at any considerable distance to ordinary navigation charts on the mercator projection, as the line of bearing on such a chart is not a straight line excepting in the meridian.

Fog Signal Stations Established

Three stations for sending radio fog signals are now in commission, Ambrose Channel Light Vessel, Fire Island Light Vessel and Sea Girt (N. J.) Light Station. These stations were selected so as to enable vessels approaching or leaving New York to locate themselves conveniently by cross bearings. The stations are identified by the characteristics of the signals, thus Ambrose Channel sends one dash, Fire Island a group of two dashes, and Sea Girt a group of three dashes, with brief intervals between the groups. The particular lighthouse on which a radio bearing is being taken in a fog is by this means just as definitely known as is the light on which a sight bearing is taken by the navigator of a ship identified by its order of flashes or color. The radio fog signals will be repeated so long as fog or thick weather lasts, and perhaps will be sent at certain specified times in clear weather to permit testing of radio compasses.

Future Development

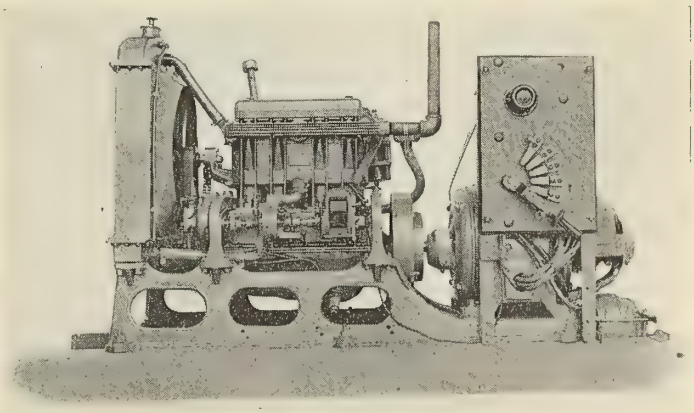
After a reasonable service test of the present group of stations in the vicinity of New York, the Lighthouse Service proposes, as means are available and needs are developed, to install similar groups in the vicinity of important entrances on the Atlantic and Pacific coasts of the country and on the Great Lakes, as well as on some of the principal intermediate capes and light vessels. For the successful utilization of the system, it is of course indispensable that the more valuable vessels at least be equipped with radio compasses, and it is believed that the additional safeguards resulting from such equipment will bring this about, particularly in view of the growing familiarity with the value of radio apparatus to shipping.

As a result of further investigation still in progress by the services mentioned and others, and of actual test and experience, it is expected there will be improvements in this system, and further applications of radio signalling for the safeguarding of navigation. It is not probable, however, that as a result of anything now in sight, the extensive system of sound fog signals, such as sirens, whistles, horns and bells, can be dispensed with, as these are of great value to vessels and boats of every size and description, many of which are not likely to be equipped for receiving radio signals; and furthermore, these furnish warning signals, the use of which is not dependent on the operation of any instrument other than the human ear.

Gas Engine Driven Arc Welding Units for Intermittent and Heavy Duty

TWO new types of gas engine driven arc welding sets, one for medium or intermittent duty, the other for heavy duty, have been designed by the General Electric Company, Schenectady, N. Y. These units are specially adapted to marine and industrial plants where work to be done is located in out of the way places and is not sufficient to warrant the installation of permanent equipment.

The medium duty equipment was designed particularly for intermittent duty. The generating unit consists of a type "W-D" 10-4 kilowatt, 1,200 revolutions per minute, 60/20 volt 200 ampere generator directly connected by a



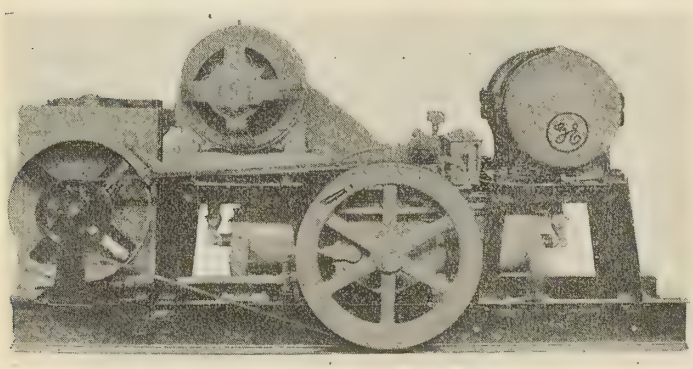
Medium Duty Welding Set

flexible coupling to a Matthews, Model F, 4 cylinder, 4 cycle, 20 horsepower gasoline engine. The engine, radiator, generator and welding panel are assembled on a rigid cast iron base, which in turn is mounted on wooden skids. The set is 86 inches long, 28 inches wide, and has a net weight of about 2,000 pounds. The gas engine used with this outfit has been especially adapted to the requirements of intermittent welding service. It is of the overhead valve type, having cylinders cast in a block with the upper half of the crank case. The lubrication is a combination of splash and forced feed, and the cooling a thermo-siphon system.

The generator is self exciting and regulating, giving practically constant energy throughout the working range. It gives a no-load, or striking, voltage of 60 which automatically decreases to the proper welding voltage (usually 18 to 20 volts) when the arc is struck. It is driven at a speed of 1,200 revolutions per minute, has a normal output of 4 kilowatts and delivers a maximum working current of 200 amperes. The panel carries the generator field rheostat and series field dial switch by which the current can be adjusted from 200 to 75 amperes in 25 ampere steps. A reactor choke coil mounted on the set and connected in the welding circuit protects the generator from current surges.

Heavy Duty Welding Set

The heavy duty equipment can be arranged to supply either one or two welding circuits. It consists ordinarily of a 20 horsepower 2 cylinder opposed Reliable Heer, Model 00,



Heavy Duty Welding Equipment

gas engine, a type "WD"-9 generator and welding panel, the whole mounted on a welded structural steel base with a net weight of 2,400 pounds for the single operator equipment and 3,200 pounds for the double operator unit.

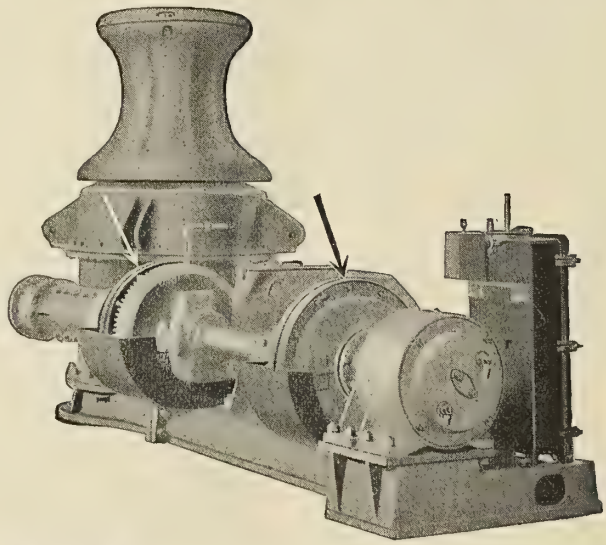
The generator is driven by a silent chain running in oil, and except for the speed its characteristics are similar to the "WD"-10 which forms part of the medium duty outfits. These generators run at 1,750 revolutions per minute, and differ somewhat in the windings because of the difference in speed and service requirements. An ammeter is mounted on the panel of each heavy duty equipment, but in other respects they are identical with the medium duty sets.

Deck Machinery for Standard Oil Tanker to Be Built at Moore Plant of Bethlehem Shipbuilding Corporation, Ltd.

The deck machinery for the 2,650-ton Standard Oil Company tanker, contract for which has been awarded the Bethlehem Shipbuilding Corporation, Ltd., will be built at the Moore plant of the Bethlehem Corporation, at Elizabethport, N. J., and will consist of a 7-inch by 7-inch Bethlehem spring quadrant type steering gear with horizontal engines, an 8¼-inch by 8-inch Bethlehem spur-gear windlass suitable for taking 1¾-inch anchor chain and a 6¼-inch by 8-inch Bethlehem steam self-contained gypsy.

Dry Dock Capstan Designed for Heavy Loads

A DRY dock capstan of the reversible, gypsy head type has recently been developed by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, for general dry dock use. The machine is designed to handle rope loads of 30,000 pounds at 30 feet per minute, 10,000 pounds at 90 feet per minute, and 1,000 pounds at 200 feet per minute.



Two-Speed Dry Dock Capstan Built for United States Bureau of Yards and Docks

The vertical barrel of the capstan is electrically driven through a worm and gear, and through two speed reductions of spur gears which make possible the load speeds given above. The speed gears are engaged by two C-H magnetic clutches produced by the Cutler Hammer Manufacturing Company, Milwaukee, Wis. These are in turn operated by a selective switch arrangement. Intermediate speeds are obtained by operating on resistance points of the controller.

The capstan barrel and operating mechanism are mounted on a heavy cast iron bed plate, the entire mechanism forming a self-contained unit. The driving motor is of the direct current, series wound mill type totally enclosed and splash proof, operating at 230 volts and having a continuous rating of 40 horsepower and an intermittent rating of 65 horsepower. The two C-H magnetic clutches used to obtain the speed reductions are each 28 inches in diameter and have a pull-out torque of 3,920 pound feet. One clutch connects the motor with the proper gearing to provide the slow speed and the other with suitable gearing for high speed. When the current passes through the magnetic clutch coil, the clutch is engaged and as soon as the current through the coil is broken the clutch immediately becomes disengaged. This is accomplished by mounting one of the clutch members on a spring plate or circular steel disk. When the clutch is energized the two parts are drawn together and the spring plate becomes slightly dished. When the clutch is de-energized the plate springs back flat again and draws the two members apart. The capstan is equipped with a C-H reversible drum type controller enclosed in a waterproof case and having the operating shaft extending through the pit cover. The outer end of the motor jack shaft is provided with a C-H electrically operated disk brake fully enclosed and waterproof.

This type capstan has been adopted by the United States Navy for the navy yard dry docks at Norfolk, Va., and Philadelphia, Pa. The Commonwealth of Massachusetts has also installed one of these capstans in the dry dock at South Boston.

Lubrication of Marine Diesel Engines

By Louis R. Ford*

The chief difference between the lubrication systems on Diesel engines designed for service on land and the marine type Diesel is the almost universal application to the latter type of the principle of forced feed of lubricant to the surfaces to be lubricated and the more common use of gravity and wick feed oiling system on the former. Isolated cases of builders who still cling to the old gravity and wick feed systems may be found in marine practice but in the majority of installations all of the more important bearings are fitted for forced oil feed and only the small bearings, in which the pressures and the rubbing speeds are low, are oiled by wick, drip or hand feed.

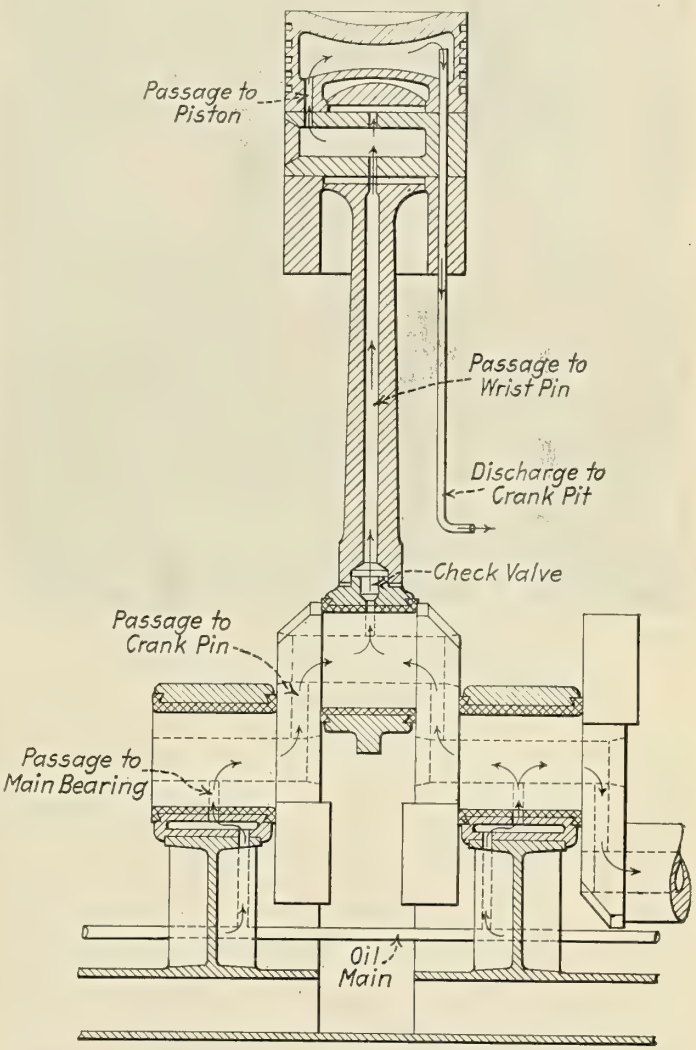
THE design of lubricating systems has become so nearly standardized that practically all builders of marine Diesel engines use the same general arrangement and only in minor details does its application to different engines vary. The main bearings, crank pins, crosshead pins, crosshead guides, cam shaft drive gears and thrust bearing are supplied with oil through the low pressure system, in which the same oil is used over and over. For the power cylinders and air compressor cylinders a separate high pressure system is used and it differs from the low pressure system in that the oil cannot be recovered after it is once applied to the rubbing surfaces to be lubricated.

In the low pressure system each of the bearings served is supplied with a large excess of oil over the amount required for adequate lubrication, the oil being forced into the bearings under sufficient pressure to cause it to spread over the entire surface of each bearing, and the excess flows out through the ends of the bearings. About the only definite requirement as to the quantity of oil that must be circulated through the low pressure system is that it must be sufficient to maintain a constant flow through all the oil passages to the various bearings, but the excess over actual lubrication requirements should be quite large in order to prevent drainage of any branch of the system through a bearing that may develop too much clearance. It should be borne in mind, however, that the larger the amount of oil circulated the greater will be the power consumption by the pump. From one and a half to two gallons per brake horsepower per hour will be found sufficient.

Course of Oil in Low Pressure System

The working supply of oil for the low pressure system is carried in a sump tank located in the double bottom just aft of the engine. The lubricating oil circulating pump draws the oil from this tank and discharges it through a cooler to the distribution system on the engine. A large oil main runs fore and aft, parallel to the engine bed, with a branch pipe leading to each main bearing and to the thrust bearings, cam shaft drive gears, or to any other special points to which it may be desirable to apply oil under pressure. The branch pipe to each main bearing is usually carried into the journal from the top, for the reason that more clear space is available there. A better arrangement is to bring the pipe in through the bottom of the journal, so that the oil may be forced between the shaft and the bottom bearing shell while the shaft is at rest, but this is somewhat difficult because of the small clearance between crank web and the cross member that carries the main bearing. A circumferential groove in each main bearing shell registers with a radial hole in the crank shaft and the oil flows through this groove and hole to an axial hole in the shaft, thence through a hole in the crank web to an axial hole in the crank pin and into the crank pin bearing through a radial hole in the pin. This radial hole registers with a circumferential groove in the crank pin boxes through which the oil flows into an axial hole in the connecting rod and up to the crosshead pin bearings or the piston pin.

In the case of crosshead type engines a portion of the oil flows from the crosshead pins through a hole to the crosshead guide. From the crosshead guide and the crosshead pins the oil discharges into the crank pit and drains by gravity back to the sump tank. In some trunk piston engines part of the oil that goes to the piston pin bearing flows through suitable passages into the piston, for the purpose of cooling the piston, and discharges from the piston to the crank pit.



Course of Lubricating Oil Through Trunk Piston Engine

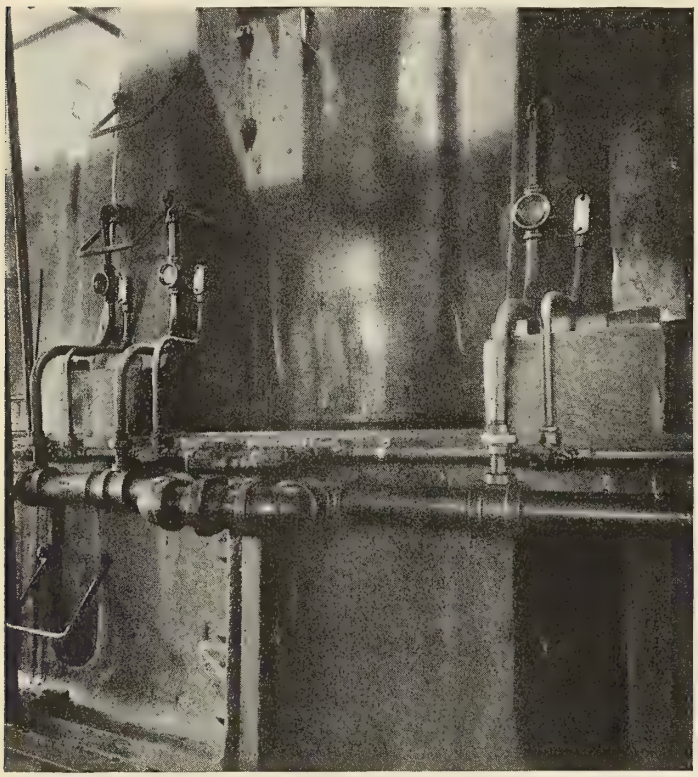
Straining Out Impurities

The end of the suction pipe in the sump tank should be fitted with a strainer to prevent entry of rags, waste or other

*Worthington Pump and Machinery Corporation, New York.

foreign matter into the suction pipe and a second strainer should be placed in the discharge line of the pump. This latter strainer should be of the duplex type, so arranged that one side can be opened up for cleaning without interfering with the operation of the other side, and with the strainer elements made in the form of baskets of fine wire gauze. As an additional precaution against clogging up the system each of the openings in the crank pits through which the oil drains to the sump tank should be covered with a perforated plate.

It is almost impossible to prevent some trash from falling into the crank pits during overhaul of the engine, and in spite of the most vigilant supervision it will sometimes happen that the pits are not thoroughly cleaned out before the engine is closed up. These various strainers take care of only such matter as may clog up the system and are not intended for



Example of Arrangement of Oil Supply Main with Branches to Main Bearings and Electric Flow Indicators in Each Branch

oil purification or the removal of suspended matter. This is the function of the filter or separator, which will be discussed later.

Owing to the fact that there will nearly always be some variation in the clearances of the various bearings, and the clearance regulates the amount of oil that will flow through the bearing and out of the ends, there will be some variation in the amount of oil taken from the main by each of the branch pipes that lead to the main bearings. This will cause a variation in the pressure in the different parts of the system, so that some of the bearings at the ends of the lines, particularly the crosshead pin bearings, may not get as much oil as the others.

Correcting Unequal Distribution

This unequal distribution may be corrected by placing some sort of restriction in each of the pipes leading to the main bearings, such as a washer or plug with a small hole drilled in it, thus permitting only as much oil to flow into each pipe as will pass through the restriction. In addition to this the oil discharge line from the circulating pump should connect to the oil main at the center of its length rather than at one end. This arrangement insures the group of bearings under each cylinder getting the same amount of oil but the equal distribution of oil to each of the bearings in each group depends upon the correct proportioning of the oil passages and the maintenance of correct clearances in the bearings.

The clearance of main bearings is particularly important in this connection; these bearings will run noiselessly with considerable clearance and, without giving any indication of their looseness, they may allow so much oil to flow out of the ends that not enough will reach the crank pins and crosshead pins. Little if any grooving of bearing surfaces should be done where forced lubrication is used; usually one longitudinal groove at the point of greatest pressure in each bearing being sufficient to distribute the oil.

The fitting of shims between the faces of the bearing boxes should receive very careful attention. The edges of the shims abutting on the shaft or pin must be cut well back so that they will not interfere with the flow of oil around the bearing, but this relieving must not be carried out to the ends of the shims, otherwise large holes will be formed at the ends of the bearings and so much oil will flow out through them that normal pressure cannot be kept in the system.

It may sometimes happen that a good flow of oil is obtained through all bearings when the oil circulating pump is operated while the engine is not in operation but the supply to the crosshead pin bearings or piston pin bearing is insufficient when the engine is running. This may be due to the inertia effect of the oil in the connecting rod, whereby the oil is forced down out of the rod when the rod suddenly changes its direction of motion as it passes bottom center. This effect is most noticeable in high speed engines. On the United States submarines this trouble was corrected by placing a simple ball check valve in the bottom of each connecting rod. This check valve promotes circulation of oil for the reason that when the rod moves upward the oil in the central passage is accelerated, the velocity thus built up assists the pump pressure after the rod passes top center and starts on the down stroke, and acceleration in the downward direction that would force the oil back against the pump pressure is prevented by the valve.

Why a Tightly Closed-in Engine Housing Is Essential

When the engine is in operation the oil flowing out of the rotating and reciprocating bearings is dashed in all directions, and every part of the interior of the housing is filled with a heavy oil mist or spray. Unless the housing is very tightly enclosed a large quantity of oil is thrown out of the engine and lost in the bilge. A tight housing is essential not only from the standpoint of economy but also from that of safety and "liveableness" in the engine room. An open housing engine with forced lubrication results in a most uncomfortable engine room, and oil covered ladders and floor plates offer very precarious footing in a seaway. Engines of the trunk piston type, as ordinarily constructed, require no special precautions against loss of oil by splashing out of the housing but in order to prevent a large amount of bearing oil being burned in the cylinders it is good practice to fit splash hoods over each crank. These hoods are made in sections and bolted to the cross members that carry the main bearings. In spite of the most careful precautions against splashing some of the bearing oil will work into the cylinders of the trunk piston engine.

The housings of crosshead type engines are closed by fitting sheet steel or cast iron plates between the frames, these plates being drawn down on cork or canvas gaskets to prevent leakage around the edges. The ease with which the oil searches out minute cracks or small openings left when fitting the splash plates is surprising and when an engine is placed in service it may be necessary to calk packing into such

openings to prevent a large waste of oil. If the design of an engine provides a closed partition between the lower ends of cylinders and the crank cases, so that no oil is lost by being carried into the power cylinders, there should, theoretically, be no loss of oil and it should not be necessary to add any additional oil until the supply in the system has been so contaminated as to render it unfit for further use; actually, however, some oil is lost by leakage at various points and the amount of make-up required depends upon the amount of care exercised in stopping small leaks in the engine housing, oil piping, pumps, strainers, etc. Even under the best conditions the loss by leakage may amount to about six quarts per day in a large engine.

An objection frequently raised against the tightly closed-in housing is the impossibility of observing and feeling the bearings. In attempting to meet this objection some builders resort to various devices such as electric flow indicators placed in the branch pipes to the main bearings; thermometers placed in the main bearing boxes, with temperature indicating scale at the operating platform; circumferential grooves in the ends of the main bearings to watch the overflow and conduct it through pipes to a point near a door in each splash plate through which the temperature of the oil flowing out of the pipes may be felt with the hand. Each of these devices has the defect that it does not give an indication of the condition of the crank pin and crosshead bearings, which are the bearings most likely to overheat. As a matter of fact, if the proper precautions regarding fitting of shims, testing out the entire lubricating system before getting under way, maintaining correct oil pressure and keeping the oil clean are observed, overheated bearings will be so rare that the engineer will cease to worry about their being out of sight.

The temperature of the oil in the return flow pipe from the crank pit should be closely observed as any overheating of bearings would be indicated by an abnormal rise in this temperature. In engines with the cylinders partitioned off from the housing and with a separate cooling system for the pistons the temperature of the oil returning from the crank pits should be only very slightly higher than that of the entering oil and the use of an oil cooler becomes unnecessary. In the trunk piston engines, however, the oil becomes heated by being splashed against the hot pistons and by contact with hot gases that sometimes leak past the pistons, so for this type an oil cooler is necessary. If the pistons are cooled by circulating lubricating oil through them this oil may be discharged into the crank pit when it mingles with the bearing oil and, of course, raises its temperature and requires the use of a cooler.

The oil cooler may be of either the straight tube or coil type and the cooling effect is obtained by circulating sea water through the cooler. For this reason the oil must be tested frequently for chlorine, the presence of which indicates that salt water is leaking into the oil, the most probable location of the leak being in the cooler. It should be remembered, however, that this salt water may enter the system from the bilge, through a defective manhole gasket on the sump tank.

Trouble from Water or Carbon in the Oil

By far the greater part of the lubrication difficulties with Diesel engines have been caused by water or carbon in the oil. For pistons above 20 inches diameter some form of cooling must be used. Because of its superior heat absorption characteristic, water is the most desirable cooling medium, and because it is available in unlimited quantity, sea water is the logical choice for marine engines. Its use, however, is restricted to engines in which the designer has eliminated all possibility of water leakage into the crank pits, because even the best lubricating oils will emulsify when salt water is added and the emulsion thus formed will clog up the lubricating system. For this reason many designers prefer to use fresh water for cooling the pistons, so that any small amount of leakage from the joints of the piston cooling system will do no serious damage.

Even with the fresh water system some trouble will be experienced, if the water gets into the oil, for an emulsion will in time be formed, though this emulsion can be broken down and the oil and water separated. In this connection it is interesting to note that this emulsion is very difficult to break down, if it contains oxide of iron. For this reason all the metal parts inside the housing should be kept free from rust. This leads to some designers using a portion of the lubricating oil for cooling the pistons. With this arrangement lubrication troubles are sometimes caused by carbonized oil flaking off from the interior of the pistons and mingling with the oil in sufficient quantity to clog small passages in the lubricating system. The tendency to carbon formation on the underside of the piston top is greatly reduced, if the cooling oil is given a high velocity through the piston.

In trunk piston engines a great deal of carbon and so called "black oil" from the cylinders will work past the piston rings into the crank pits and mix with the lubricating oil. This cylinder carbon interferes with lubrication both by retarding circulation in the system and by reducing the lubricating qualities of the oil. Although it is commonly referred to as carbon it actually consists of a mixture of carbon, metal dust and other impurities, such as sodium sulphide, that may be deposited out of insufficiently washed fuel oil.

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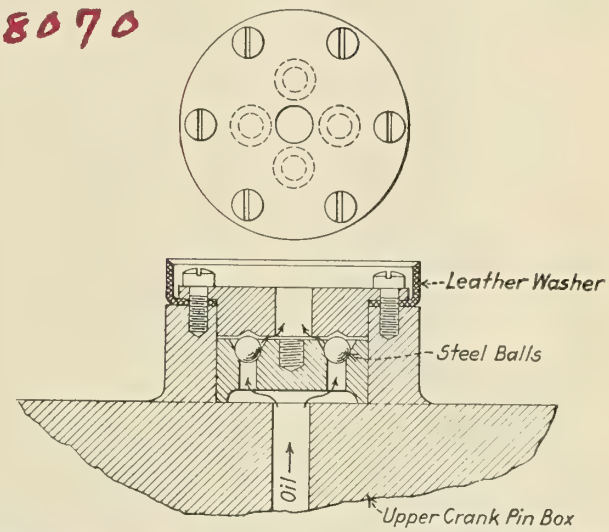


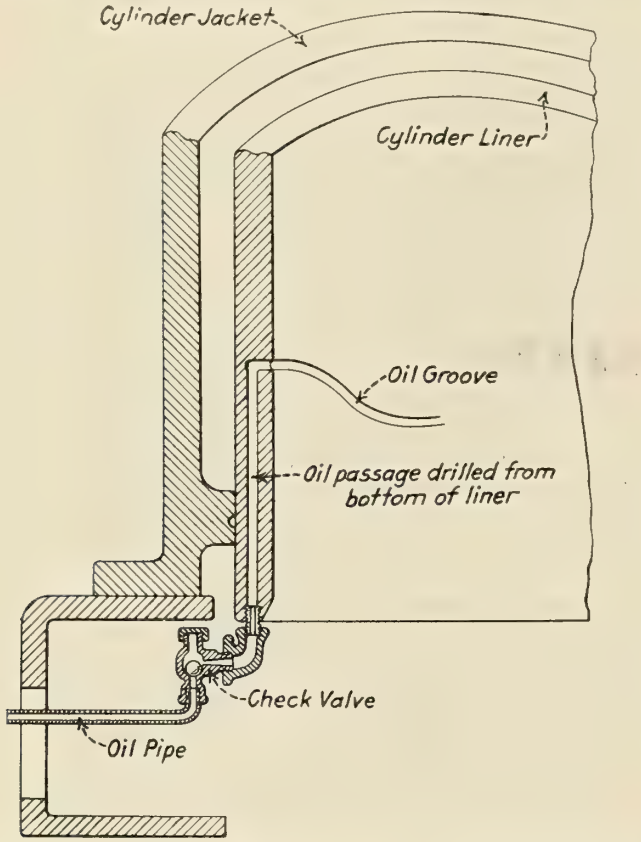
Check Valve Placed in Upper Crank Pin Box Oil Passage to Connecting Rod

Oil Filters

It is customary to include some sort of filter in the low pressure lubricating system, and the connections are so arranged that continuous filtering may be carried on or a portion of the oil may be taken out of circulation and filtered then returned to the system. In these filters the oil is usually heated, then passed through muslin, flannel, felt or fullers earth, and in some cases separate compartments are provided in which the oil may be treated with chemical reagents for the removal of suspended carbon. A comparatively recent development in this line is the centrifugal separator which utilizes the difference in specific gravities of the oil and any foreign matter contained therein to cause separation by centrifugal force in a whirling chamber. A simple method of removing water from the oil is to provide a tank in which a portion of the oil may be allowed to stand without agitation so that the water will settle to the bottom. Rapid separation of water is promoted, if a steam coil is placed in this tank

for heating the oil. If the ship lies in port any considerable length of time and the oil in the sump tank is not disturbed, the water contained in the system will settle to the bottom of the tank. For this reason a pump connection at the bottom of the sump tank should be provided so that this water may be pumped out before the lubricating oil circulating pump is started. This connection will be found useful in case a large water leak develops while under way at sea, to prevent water accumulating in the sump tank in sufficient quantity to raise the oil above the circulating pump suction.

For drainage of oil from the crank pits to sump tank a hole is usually provided in the bottom of each crank pit, connecting with a fore and aft duct cast in the under side of



Method of Attaching Oil Pipe to Liner Without Entering Water Jacket Space

the bed or with a pipe main flanged to the bed. The best method of applying strainers to these openings is to cast a pocket in the bottom of each crank pit and cover the pocket with a perforated plate.

High Pressure Lubricating System

The high pressure lubricating system supplies oil to the power cylinders and air compressor cylinders and consists essentially of a number of multiple unit pumps, commonly referred to as mechanical oilers, and the necessary pipe leads to the points of application of the oil. The usual form of mechanical oiler is a group of pumps mounted in an oil reservoir, the pumps receiving their motion through an eccentric or gear connection to some rotating part of the engine, usually the cam shaft, and the number of pumps in one oiler may vary from one to twenty-four, depending on the number of points to which oil may be applied simultaneously. Each pump is a double unit and so arranged that the first pump in the unit draws oil from the reservoir and delivers it into the suction of the second pump which in turn delivers it to the point to be lubricated. The amount of oil delivered is regulated by throttling the suction of the first pump by means of a hand regulating screw. These mechanical oilers are mounted on the fronts of the engine frames or in some other easily accessible place. A very necessary pump characteristic in any type of mechanical oiler is the ability to handle a very small quantity of oil in one stroke.

The number of inlets to each cylinder, and consequently the number of pumps required for each cylinder, is largely a matter of opinion. Some engines have been built with as many as eight oil pipes entering the cylinders while others operate very successfully with two. In the latter case oil grooves of ample length should be cut in the cylinder liner, extending on both sides of the inlet hole, to distribute the oil. In order to reach the cylinder liner the oil pipe must pass through the jacket water space. For this reason the pipe connection at this point is usually by means of a short tube screwed into the liner and passing through a stuffing box in the cylinder jacket. If this tube is rigidly connected to both liner and jacket, trouble may be experienced due to the expansion of the tube when hot causing it to push against the liner hard enough to deform the liner and cause the piston to jam. This connection even when made up carefully is a source of considerable trouble in service. In the case of large engines where the liner thickness is sufficient and the lower end of the liner is accessible the oil pipe connection may be made at the bottom of the liner, as shown on this page. In this case no expansion difficulties will be experienced, there is no water joint through which water may leak into the cylinder.

Cylinder Lubrication

The oil hole in the cylinder liner should be so located that when the piston is at the bottom of its stroke the top piston ring is above the hole; if located higher than this, some of the lubricating oil will be deposited on top of the piston where it serves no useful purpose. Were it not for the necessity of discharging the oil into the cylinders at a definite time in the cycle all the lubricators could be grouped into one large unit, with a single operating gear. It is necessary, however, to time the pumps to each cylinder so that the oil will be forced into the cylinder when the piston is at the bottom of its stroke and in four cycle engines this should be at the end of the power stroke so that there will be a minimum of pressure in the cylinder during the time the oil is being spread over the surface of the liner by the movement of the piston.

No definite rule can be stated for the amount of oil required to lubricate any one cylinder other than to say that the condition to be aimed for is a light coating of oil over the entire surface of liners and rings with no carbon or gummed oil in the ring slots. The rate of feed to which the pumps must be adjusted to maintain this condition can be determined only by experience in each particular case, but it should not be necessary to use more than one gallon of oil per ten thousand horsepower hours.

Whenever a cylinder is opened up the lubrication conditions should be carefully observed as a guide to lubricator adjustment. In two cycle engines the surfaces of the liners in the vicinity of the exhaust ports and the bridges between the exhaust ports are most difficult to lubricate owing to the tendency of the exhaust gases to sweep the oil off of these surfaces as they rush out of the ports at high velocity. The metal in this vicinity attains a high heat that tends to interfere with lubrication and this condition is met in some designs by making the exhaust port bridges hollow and passing water through them. This arrangement has a good effect in reducing heat stresses in the structure but its value as an aid to lubrication is negligible since it has no influence on the chief lubrication disturbing factor, the sweeping of oil off the surfaces by the rapidly moving exhaust gases.

In locating the mechanical oilers it is desirable to place them below the level of the oil inlet holes in the cylinders, so that the oil will not drain out of the pipes while the engine is shut down. The pumps deliver very small quantities of oil

into the pipes per stroke and, if the pipes between pumps and cylinder are empty when the engine is started, the length of time required for the oil to get to the cylinders may be great enough to cause considerable damage to the cylinder liners and rings. If the oil lines to the cylinders have been disconnected at the pumps for any reason while the engine is shut down, the pump operating gear should be disconnected and the pumps operated by hand, before the engine is started, long enough to fill the pipes.

In the case of the trunk piston engines one of the most common troubles is the admission of an excessive amount of oil to the power cylinders due to the oil spray in the housing depositing on the cylinder walls and pistons. It has been found in recent years that with the engines of this type the mechanical lubricators may be dispensed with and dependence placed on the oil spray for lubricating the cylinders. The highly successful German submarine engines are not equipped with mechanical lubricators for the power cylinders.

Lubrication of Air Compressor Cylinders

The air compressor cylinders are lubricated by mechanical oilers similar to the ones used for the power cylinders, but the pumps should be adapted to handle a smaller quantity of oil per stroke than is the case with the power cylinder lubricators. Not only is less oil per stroke required for adequate lubrication of the compressor cylinders but there are two other important reasons for reducing this oil supply to a minimum. The moisture contained in the air forms an emulsion with the oil and if an excessive amount is supplied, this emulsion will form a jelly that will clog piping and valves and interfere with the spraying of fuel into the power cylinders. With excessive oil supply to the compressors there is the ever present danger of an explosion of the mixture of oil vapor and air that may be formed in the high pressure air system. When the air compressor piston is made in the form of a single acting differential piston with the lower end of the cylinder open to the crank case it is customary to place the second stage next to the crank case so that the pressure in the cylinder will tend to prevent oil vapor from the crank case being drawn up into the compressor, but even with this arrangement it will be found that a large amount of oil will sometimes work up into the cylinder, in spite of the pressure. To guard against this a scraper ring should be placed near the bottom end of the piston to scrape the oil off the cylinder wall on the down stroke. This matter of oil in the air compressor and spray air system is one that should receive very serious consideration from the operator and it should be made a rule to steam out the whole air system at least once a year.

Selection of Lubricating Oil

There has been so much written about lubrication from the scientific standpoint and there are so many lubrication hobbies exploited that the marine Diesel operator confronted with the selection of the proper kinds of oil to use is likely to be somewhat puzzled. As a general rule it is safe to accept the recommendation of reliable manufacturers of oils as to the most suitable oils for Diesel engine use, for these companies have given a great deal of expert attention to the production of these oils and their laboratory work has brought out some very interesting facts concerning the behavior of various lubricants under the conditions met in Diesel engine practice. The operator should not, however, depend too much upon the mysterious virtues of some particular brand of oil to solve his lubrication difficulties, but rather give a little intelligent thought to the requirements of his machine and the characteristics of the oil necessary to meet these particular requirements.

Fundamentally the function of a bearing oil is to maintain an unbroken film between the moving surfaces so that there can be no contact between these surfaces. It has been demonstrated experimentally that the metal surfaces in a bearing do not slide upon this film; both surfaces of the film adhere to the metal, so that one surface is stationary while the other is in motion and somewhere between the two the oil is pulling apart and sliding upon itself. The force required to tear this film and permit the two parts to slide upon each other represents the friction load in the bearing and its amount depends upon the viscosity of the oil. From this it follows that the lower the viscosity of the oil, or in other words the more fluid the oil, the less will be the friction and the most fluid oil obtainable will be best lubricant, if we consider only the internal friction of the oil. This conclusion is modified however by the fact that the more fluid the oil is the more easily it is squeezed out from between the bearing surfaces by the pressure on the bearing. It is necessary then to use oil the viscosity of which is high enough to prevent squeezing it out of the bearing.

It may be stated as a general rule that the best oil for any bearing is the lightest oil that will stay in the bearing under the maximum pressure to be expected in that bearing. Theoretically each bearing on the engine should be supplied with the oil best suited to its particular service, but this is impossible, due to the complicated equipment and multiplicity of oils that would be required. Actually the requirements of the major bearings, such as main journals, crosshead pins and crank pins determine the kind of oil to be used throughout the engine, excepting the interior of the cylinders which must be considered separately.

For use in the forced lubrication system a prime requisite is that the oil must not emulsify, when water gets into the system, to a degree that will not permit restoring it to its original state, neither must it foam too much when beaten up in the system and mixed with air. This eliminates vegetable, animal or compounded oils from consideration and necessitates the use of straight mineral oils. The oil must be free from acids that would attack the metal of the bearings and must, of course, contain no solid matter.

For power cylinder lubrication the oil must have a high flash point, over 500 degrees F., to prevent it being burned off the cylinder walls too quickly, must be free from acid and its viscosity should be high enough to make it a good sealing agent between piston rings and cylinder walls. If an engine has been in operation long enough to have badly worn cylinder liners or piston rings, it may be found desirable to use an oil of much higher viscosity than was used while the engine was new. This oil will tend to prevent leakage of gases past the rings. Investigators in England have found that when using fuel oil with a high sulphur content the sulphur reacts on the lubricating oil and causes a sticky deposit in the cylinders.

The conditions to be met inside the air compressor cylinders are, from the standpoint of lubrication, the most difficult of any in the engine. In addition to the heat resisting qualities and piston ring sealing qualities required in the power cylinders the air compressor oil must be able to adhere to the metal surfaces in a very wet medium. A great deal of moisture is deposited out of the air in the compressor and this moisture tends to wash the oil off the cylinder walls. For this reason it is desirable to use an oil that will form an emulsion with the water and stick to the metal. As previously pointed out the emulsified oil is sometimes a cause of considerable trouble in the air system but it is necessary for it to emulsify in order to have any value as a lubricant in the compressor. For this service a compounded oil is desirable.

A great many engineers are partial to clear oils and are inclined to think that an oil with a nice amber color must necessarily have good lubricating qualities. As a matter of fact color and lubricating value have no relation to each other; the normally dark oils are treated in order to lighten their color only because of the general trade preference for the light color.

Motorship Yngaren on Her Sea Trial, June 14, 1921

The Motorship Yngaren

By Our Special London Correspondent

No event of recent months has aroused so much interest among the shipping, engineering and shipbuilding community in Great Britain as the trial trip of the motorship Yngaren which was carried out in the middle of June. The reason is that this vessel is the first of a series of standard ships which William Doxford and Sons are building and equipping with their remarkable opposed piston oil engines. The motor in the Yngaren is the highest powered set that has yet been installed in any vessel and the great confidence of builders and owners is indicated by the employment of a single screw installation.

HITHERTO there has been some hesitation in the adoption of only one engine in a motorship but all fear now appears to be dispelled, and, even in the case of a motor which is the first of its type, shipowners are quite prepared to install only one set and not take advantage of the safeguard afforded by a twin screw arrangement. Naturally there is a good deal to be said for the employment of single screw cargo ships, especially when, as in the case of the *Yngaren* described in this article, the motor runs at what is practically steam engine speed, namely 77 revolutions per minute.

Nothing could illustrate better the real attitude of shipping men and shipowners towards the motorship than the fact that the Doxford type of motor has been designed in such a way that it can be installed in a very large number of existing steamers in replacement of the steam engines. In fact, the *Yngaren* so far as the hull is concerned is a sister vessel to the famous Doxford standard steamships, and it is no secret that the builders hope in the course of time that all the standard vessels which they have built will be converted into motorships fitted with their oil engines.

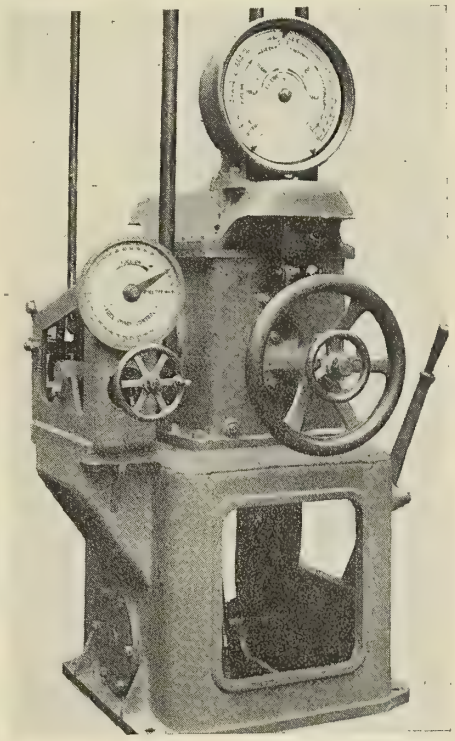
The *Yngaren* carries 9,350 tons of cargo on a draft of 25 feet 6 inches, being 420 feet in length with a beam of 54 feet and a depth molded of 37 feet. She has been constructed for the Transatlantic Steamship Company of Gothenburg, which is the owner of a number of Burmeister and Wain engined vessels. So convinced are the owners of the success of this type of engine that they have two more vessels under construction, the first of which will be completed in the next few months.

The Opposed Piston Engine

The propelling engine of the *Yngaren* has already been described in Marine Engineering. The designed output is 3,000 indicated horsepower, and owing to the fact that no air compressor is used and most of the auxiliary pumps are separately driven, the high mechanical efficiency of 90 percent is attained giving a total shaft horsepower of 2,700. As is well known the Doxford engine adopts the opposed piston principle and there are four cylinders, the diameter being 580 millimeters and the stroke of each piston 1,160 millimeters. On the trials it was amply demonstrated that the opposed piston motor possesses definite advantages. The cushioning effect was very notable, giving an almost complete absence of vibration, and the engine is without question the quietest running Diesel motor that has ever been built for marine work.

From the standpoint of the man operating the engine

the simplicity of the control is an outstanding feature. As most engineers are aware, on the majority of Diesel engines there are at least two levers or wheels to be used for starting and maneuvering. Often there are three, but in the Doxford opposed piston engine there is merely one, a large hand operated wheel. The engineer has therefore to do nothing more than he would in starting a steam engine. To go in the ahead direction, he turns the wheel to the right, and the more he turns the wheel, the faster the engine runs until full speed is attained. For the astern direction, he merely turns the wheel to the left with the same result. Moreover, the engine does not start off with a rush as is usual but slowly picks up, and if the order comes to go slow ahead, the engineer merely turns the handwheel until he sees the speed counter indicating about 20 revolutions per minute. The engine will then continue to run at this speed as long as is required. It is not necessary in the first place to speed the engine up to the maximum and then bring it down, as is the ordinary method.



Control Station of Doxford Engine

The only thing against the engine so far as can at present be judged is that it requires three hours' warming up by steam before it can be started, this being due to the low compression pressure adopted—about 300 pounds per square inch. The solid injection is effected at about 8,000 or 9,000 pounds per square inch and during the trials this seemed to operate perfectly. An arrangement is made whereby, in the event of a failure of the fuel pumps which are driven off the crankshaft, an auxiliary set operated by an electric motor can immediately be brought into action. There is thus little likelihood of any failure arising due to a breakdown of pumps.

The Auxiliaries

Even in the engines used for driving the dynamo Doxfords have employed the same principle as in the main machinery. Three opposed piston oil engines with two cylinders 7 inches in diameter are installed and these also operate on solid injection at 8,000 pounds per square inch. They develop 100 brake horsepower and must have been somewhat difficult sets to design; on the trials they showed some signs of bad governing. However, it is understood that the builders had to produce the engines at very short notice on account of a change of plans and no doubt this small defect will be readily overcome.

Motor "Tramps"

Although in some quarters the possibility of America making great strides in connection with motorship development is scouted, this is not the general view as instanced in a recent lecture given by Mr. Barfoed, one of the directors of Burmeister and Wain of Copenhagen. He remarked that he considered American shipowners would very shortly build up a fleet of motor vessels and that with the low price of oil fuel in America these ships would sweep all the European coal fired steamers out of competition. He therefore concluded that the only hope for European steamship owners to meet this fierce competition, which would undoubtedly arise, was for them to convert their steamers to motorships.

Mr. Barfoed also brought forward some very interesting facts in connection with motor tramp ships. He pointed out that although hitherto the Diesel vessel had generally been considered as specially adapted for long voyages and fixed routes, recent developments have shown that it would make an admirable tramp on account of its low fuel consumption with the consequent possibility of carrying sufficient bunkers for a voyage around the whole world. He produced figures relating to some tramp ships which are now being built, showing that the motor vessel could carry freight at a price over 60 percent lower than was possible with a corresponding steamer. This paper has attracted considerable attention in European shipping circles, for the idea of a motor tramp ship is somewhat new and in many respects attractive.

The New Tosi Engine

Hardly a month now passes without some entirely new development in the evolution of the motorship being made. While perhaps chief interest centers round the construction of new types of two cycle Diesel motors there are still some novel four stroke engines being produced and among these none is more interesting or more important than the Tosi design now being constructed in Great Britain by Beardmores.

Their first engine is complete and is now running tests. It develops 1,200 brake horsepower in six cylinders 24⅜ inches diameter and 38⅜ inches stroke and those who have seen it in operation say that it is something very original and promising. It has an entirely new design of fuel valve, eliminates one of the valves in the cylinder cover, leaving only three to be actuated, and is controlled and maneuvered by hand without the use of compressed air. The exhaust gases are discharged from the same valve which admits the atmospheric air on the suction stroke. This is effected by the intermediary of what is called a director semi-rotary valve arranged within a Y-shaped pipe leading from the valve.

There are many other new features in this engine and it is hoped to give a fuller description in the course of a short time.

Experiments with Semi-Diesel Engines Using Vegetable Oils as Fuel

By Commander Eugenio Normand

SOME interesting experiments have been completed in the Ansaldo San Giorgio Works, at Turin, Italy, where some very successful tests on a semi-Diesel engine were made using certain types of vegetable oils instead of the usual heavy mineral oil.

The engine used in the experiments was a mono-cylinder engine of 20 brake horsepower running at a speed of 400 revolutions per minute. It was taken from stock and it is of the same type that is normally built and sold by Ansaldo San Giorgio.

These engines present the two following remarkable features:

1. No injection of fresh water.
2. Controlled admission of scavenging air.

The injection of water, according to the opinion of some eminent technicians, among whom may be mentioned Professor Eng. R. E. Mathot, of Bruxelles, who assisted in the

experiments, is a matter that is no longer necessary. This proceeding was only a remedy to a defect of cooling in the combustion chamber and as this defect has been eliminated there is no need for the remedy.

In the engines on which the experiments were made, this elimination was effected by a convenient disposition of the circulating water, which also cooled the cylinder cover. This was accomplished in the cylinder cover by a large oblique canal which connected the interior of the cylinder to the hot bulb fitted directly on the cover. This arrangement prevented the bulb from reaching too high temperatures and requiring the injection of water into the interior of the cylinder.

Admission of Scavenging Air

Controlled admission of scavenging air is secured by a device by means of which the volumetric efficiency of the air drawn into the cylinder can be maintained as high as possible and always in proportion to the quantity required for the scavenging work. In this way better combustion is secured, a higher efficiency of power obtained and the resistance offered to the air by the ordinary automatic valves suppressed.

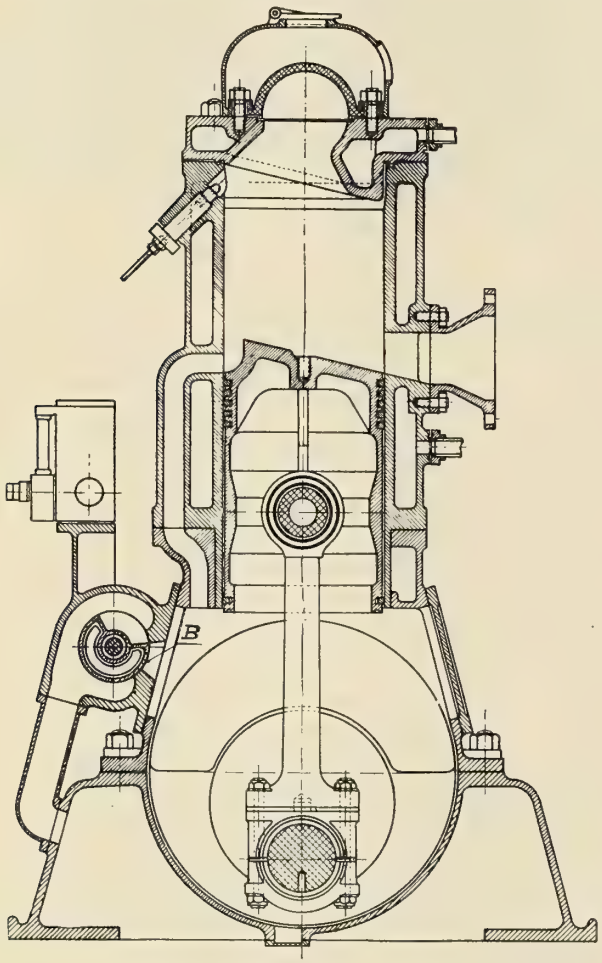


Fig. 1

With this device (see rotary cylindrical valve *B*, Fig. 1), the working conditions were observed for charges varying from 20 to 120 percent of the normal.

The engine founded on the two cycle system, with the consequent absolute absence of valves, will work with any type of mineral heavy oil, and it was therefore anticipated that the same engine would also work successfully with vegetable oil.

Results of First Series of Experiments

The first series of experiments with an engine of 20 brake horsepower at 400 revolutions per minute was made employing ordinary heavy oil with a specific gravity of 0.9. The results were as follows:

R.P.M.	*B.H.P.*	*Consumption per H.P. Hour*
405	23 5	260
411	27.3	293

It is to be observed that the consumption of fuel is noteworthily low for a high speed engine working at an overload.

The second series of experiments has been made with Winter cotton oil having the following characteristics:

Color = yellow (straw).
Limpidity = opalescent.
Density at 15 degrees = 0.920.
Inflammability temperature = 185 degrees Centigrade.
Ignition temperature = above 250 degrees Centigrade.
Reaction = neutral.
Calorific power = 9,573.

Results of Second Series

The experiments carried out with the cotton oil have given the following results:

R.P.M.	*H.P.*	*Consumption per H.P. Hour*
412	22.8	299.1
413	25.7	340.9

With heavy oil the discharge of the burnt gases was absolutely invisible, but with cotton oil there were slight smoky traces.

The third series of experiments was made with palm oil having the following characteristics:

Color = yellow.
Consistency = buttery.
Density at 15 degrees = 0.9.
Engler viscosity at 50 degrees = 3.5.
Inflammability temperature = 280 degrees Centigrade.
Ignition temperature = 325 degrees Centigrade.
Calorific power = 9,350.

As may be seen, the values of the viscosity and density, and the points of inflammability and ignition are all high in comparison to the heavy oils usually employed. The use, therefore, of vegetable oil as fuel does not appear to be possible with all types of engines.

Results of Third Series

The results of the third series of experiments were as follows:

R.P.M.	*H.P.*	*Consumption per H.P. Hour*
423	21.1	312
395	24	328

The consumptions, compared with those of heavy oil, are higher but the ratio is nearly equal to that of the calorific powers.

With palm oil as fuel the discharge of burnt gases was nearly invisible.

After the experiments, the bulb was removed and only very slight traces of carbonaceous deposits were found.

The above experiments are very important owing to their essentially practical nature leading to a further extension of the use of hot bulb engines. Moreover, the characteristics of solidity, simplicity and easiness of operation of such engines have caused them to be widely adopted. There is a still wider field for their employment in the extended colonial territories, as well as in all those countries where vegetable oils abound, and where natural conditions of the ground, difficulties and lack of transports and distance from the oil wells make the supply of mineral fuel oil difficult and dear. These conditions have heretofore nullified to a large extent the economical advantages offered by the hot bulb engines.

Eskil Berg, of the General Electric Company, Schenectady, N. Y., sailed from New York Saturday, July 23, for a two months' vacation trip abroad. Mr. Berg was a passenger on the steamship *Dottningholm*. He will tour Scandinavia and England.

Diesel Electric Propulsion*

By J. B. Bassett†

Those who have made a broad study of the subject of ship propulsion recognize that the type of drive best suited for a given ship depends upon the characteristics of the ship, its trade route and the cargo to be carried. These factors are so diversified that a definite rule cannot be set. Each class of ship must be considered separately, and very often particular ships must receive individual study. Because of these uncommon factors, there must be more than one type of propulsion, at least for the present.

THE prime requisite of propelling apparatus is reliability. Important, but secondary considerations are economy, simplicity, cost, weight and space. The ideal drive, therefore, is that which combines reliability with all of the secondary considerations. Reliability, however, must not be sacrified for any other consideration and one must not be unmindful of the fact that the lives of the crew and passengers and the safe transport of the ship and its cargo depend absolutely upon the successful performance of the propelling machinery. The machinery must operate continuously for days and weeks, and sometimes for months, without shutting down. It is recognized that no machinery has ever been built that must not be overhauled and repaired occasionally, and since this is necessary, maintenance and repair must be given careful consideration. All parts of the machinery must be designed to be accessible without unnecessary preliminary disassembling.

For the present, it is probably best to limit the capacity of Diesel electric drives to approximately 6,000 horsepower, on account of the development of high speed Diesel engines. It is difficult to predict, however, the maximum capacity which this drive will reach as the present limiting factor is the engine. The electrical machinery offers no obstacles as it has been developed to a high state of reliability and perfection over a number of years.

Multiple Generating Units May Be Used

With the Diesel electric drive, any reasonable number of generating units may be used, independent of the number and arrangement of the propellers. It is, therefore, possible to use a number of relatively small, reliable, high speed Diesel engines driving direct connected generators. The use of small engines eliminates practically all of the disadvantages of large engines, as the bores are small, thus reducing the heat stresses in the cylinder walls and piston heads to a minimum, and cooled pistons are not necessary. A number of small engines have a direct advantage in the way of repairs, as most of the overhauling could be done at sea, if necessary.

Most Suitable Type of Electrical Machinery

Let us now consider the type of electrical machinery which is best suited for Diesel electric propulsion. Relatively speaking, Diesel engines of capacity suitable for ship propulsion are inherently slow speed machines as compared with turbines. Their speed regulation under varying loads and their capability of speed control are limited especially when operating in parallel, and these features have a direct bearing on the type of generators. To successfully operate alternating current generators in parallel necessitates very close speed regulation of the prime movers and unless the angular displacement between two alternating current generators operating in parallel is kept within plus or minus approximately three electrical degrees (6 electrical degrees total), there will be an interchange or surging of current between the generators. As 360 electrical degrees constitute the space between like poles, it is very evident that the engine governors would have to be highly refined and always in perfect operating condition. Further, considerable flywheel effect would have to be incorporated in the engine in order to reduce the angular variation in speed to the required minimum.

To obtain an idea of the small displacement, let us consider a 50 cycle installation in which the engines operate at 300 revolutions per minute. For this frequency and speed, the generators would have 20 poles total, or 10 pairs of poles. The permissible angular variation in mechanical degrees would, therefore, be 0.6 degree.

While such operation is successfully carried out in several land installations where the prime movers operate at constant speed, it is not considered safe practice on board ship where speed of all sets would have to be varied simultaneously. It is for this reason that alternating current is not suitable for use with Diesel electric propulsion. On the other hand, direct current not only obviates all these difficulties but possesses many decided advantages in the way of control and reserve power. With alternating current, the propeller speed would have to be varied by varying the engine speed, whereas with direct current the propeller speed is varied by adjusting the generator voltage with the engines operating always at constant speed.

Although parallel operation with direct current is not impractical, it does encounter some difficulties when voltage control is used, which are not easy to overcome. For instance, as the propeller speed is most economically and conveniently controlled by varying the generator voltage, parallel operation would necessitate very closely and carefully adjusted generator field rheostats, or generators with practically identical saturation curves and close regulating engines. For small powers where little maneuvering and practically no reduced speed running are required, armature rheostatic starting and control could be used but for large powers this adds unnecessary weight and complication besides being wasteful at reduced speed operation.

Series Operation of Generators Ideal

The series operation of generators, however, is ideal from every standpoint such as operation, control, economy, simplicity, flexibility, etc. From the engine standpoint, series operation of generators offers the best arrangement as close regulation is not required, and thus simple governors are entirely satisfactory. From the electrical system standpoint, the series system has certain decided advantages over the parallel system, particularly as it permits the most simple and convenient arrangement of the voltage control system. The operation is independent of variation in voltage between the different generators.

With the series arrangement, more power can be obtained from remaining generator units in case of failure of one or more generator units, without providing excess capacity in the motors. The reason for this is that each of the re-

*From a paper read before the Ocean Marine Engineers' Beneficial Association No. 80, New York, February, 1921.

†General Electric Company, Schenectady, N. Y.

maining generators can be operated at normal voltage and the field of the motors weakened to increase the propeller speed to a value which will load the remaining generator units to their full capacity. With parallel operation, it would be necessary to lower the voltage of each generator a certain amount, thereby operating them at reduced capacity; or else to operate the remaining generators at full voltage and provide additional field capacity in the motors so that the speed could be lowered the required amount by increasing the motor field. Thus, in case of failure of a generator unit, parallel operation would either afford slightly less power than series operation, or would necessitate slightly larger and heavier motors.

Series connection of the generators with the motors interposed to reduce the ground voltage to a minimum has certain advantages over parallel connection of generators. For the purpose of discussion, let us assume a single screw drive consisting of six generators and a motor consisting of two separate units mounted on the same shaft. Electrically, the machines would be arranged in series as follows: Three generators, one motor unit, three generators, one motor unit. On the basis of 250 volt generators, the maximum ground voltage would be 750 volts, although from the standpoint of current, the system has all the advantages of a 1500 volt circuit. This arrangement of generators and motors is independent of the number of either, even with an uneven number of generators in a series, the motor units may be on different screws, as in the case of a twin screw drive, and still permit independent control of the port and starboard screws. However, with the same or opposite rotation of the screws, the amount of speed difference obtainable is somewhat limited, although wholly within requirements. In this case, the speed difference between the propellers is obtained by adjusting the motor fields. An even number of generators is preferable, however, with twin screw ships as it affords more flexible control.

Speed Control Simplified

An important operating advantage of the Diesel electric drive is the simple and convenient manner in which the speed is controlled. The motors and generators being simple wound shunt machines, it is practical to control the speed of the motor by what is known as the Ward-Leonard system. With this system, the motors are separately excited at constant voltage in one direction and the generators separately excited from the same source, but at a value and direction to suit the results desired. The speed of the motors under these conditions is directly proportional to the voltage of the generators. Therefore, any speed from zero to the maximum in either direction of rotation is obtained by simply manipulating the generator field rheostat. Since only the excitation power which amounts to 1 to 1½ percent of the generator rating is handled in the rheostat, the simplicity and economy of the system are evident. The type of rheostat usually used in such cases is permanently connected across the line and the leads to the field connected to adjustable arms so that it is not even necessary to open the generator field in going from full speed ahead to full speed astern. The armature circuits are connected through knife switches and circuit breakers. The latter are provided merely to protect against abnormal overloads. When it is desired to operate one screw of a twin screw ship in the reverse direction, it is merely necessary to reverse the motor field excitation. These operations are very conveniently controlled by simple levers at the control stand in the engine room. The switches and levers are easily interlocked in order to prevent improper operation.

Flexibility of Reserve Power

The Diesel electric system of ship propulsion possesses a flexibility of reserve power in the case of failure of prime movers which far surpasses any other type of drive. For example, assume a case in which there are three generators and one motor. Should one of the engines fail, the remaining two units could be operated at full capacity, giving two-thirds the total voltage and the motor speed increased by weakening its field to a point where the propeller would require two-thirds of full power, with a resulting ship speed of approximately 88 percent. In the case of two engines failing, the available speed of the ship would be approximately 70 percent of full speed. And to assume the remote case of all main engines failing, the ship could make steerage way on one of the auxiliary generating sets. By auxiliary generating sets is meant the sets furnishing the excitation and power for sea auxiliaries.

The multiplicity of units of the Diesel electric system affords another advantage of great importance, namely that units can be overhauled at sea without entailing any serious loss of speed.

With Diesel electric drive there would be no necessity for having any steam aboard the ship as all auxiliary apparatus can be more efficiently driven by electricity and the heating of quarters, cargo space and fuel or cargo oil, when necessary, could be done electrically.

With the Diesel electric drive it is not necessary to use starting air during maneuvering, as the engines are not stopped; all the control and movements of the propeller being done through the electrical machinery. The only time starting air is used is when the engine is started in preparation for "stand by." It is unnecessary to call attention to the importance of this advantage.

Auxiliaries

Mainly for reasons of control, it is decidedly preferable to isolate the propelling equipment when at sea and to provide a couple of small auxiliary sets, each having sufficient capacity to furnish the sea load and excitation. As the ship's motor driven auxiliaries are usually designed for 230 volts, the auxiliary generators should be either of the 3-wire type wound for 240/120 volts so as to provide 120 volts for lighting, or a motor generator set should be installed for lighting. It is desirable, of course, to have duplicate sources of power for lighting. A second alternative for the lighting circuits would be to have separate sets for lighting only.

While in port, the main propelling sets may be used to supply the auxiliaries and for this purpose they are provided with series windings which are connected in circuit so that the machines will operate as compound wound generators when so used. When used for propelling purposes, the series winding is not in circuit and the generators, as well as the motors are operated as pure shunt machines. These sets are usually of the 250 volt class.

Where the number of main sets is relatively large, it would not be necessary to carry duplicate auxiliary sets for the sea auxiliary load, as in case of failure of the auxiliary set one of the main sets could be separated from the propeller load and used for supplying the auxiliary load without an appreciable loss in ship speed.

The flexibility of arrangement of the Diesel electric driving machinery is so great that any emergency can be easily taken care of. Of the two arrangements of Diesel drive, the Diesel electric has the following advantages:

Less weight and consequently more cargo,
Better arrangement of machinery,
Propeller speed can be selected for best performance,
Extreme flexibility of reserve power,
Simplicity and extreme flexibility of control,
Should show lower maintenance costs,
Equal or higher net return on investment,
No starting air required during maneuvering.

Comparison of Principal Drives

As a summary, the following table of comparison of the various principal drives will be of interest. In arriving at

the figures given, all items of machinery and supplies necessary to the main propelling machinery were considered; foundations, water, fuel, etc., were taken into account. However, it was necessary in some cases to make certain assumptions, but an effort was made to place such assumptions on the conservative side, so as not to show an exaggerated comparison. Further, certain major figures are at great variance in practice, and the table is, therefore, given as indicative of the trend of this comparison rather than actual proportions. The figures for turbine electric drive and geared turbine drive are based on the same steam conditions.

The figures are based on a 3,000 horsepower ship operating over a 4,000 mile course at a speed of 11 knots, and making a total of 14 single trips per year. The geared turbine ship is taken as unity. Owing to the present unsettled conditions, it is hardly possible to make an intelligent cost comparison.

Drive	Fuel Consumption	Machinery Weight
Geared turbine	1	1
Turbine electric	1.06	1.05 to 1.10
Direct connected Diesel	0.49	1.10 to 1.25
Diesel electric	0.57	0.75

Motorship Kennecott Makes an Economical Voyage From the Pacific Coast to New York

THE largest American built motor vessel in actual service, the *Kennecott*, owned by the Alaska Steamship Company, a subsidiary of the Kennecott Copper Corporation, recently arrived in New York from the Pacific Coast with a cargo of about 3,000,000 feet of lumber and ingot copper. The vessel is of about 6,500 tons deadweight, 360 feet long, 49 feet 6 inches beam and draws 22 feet 3 inches loaded. She was built by the Todd Shipyards Corporation, at Tacoma, and is propelled by two McIntosh & Seymour, four cycle, marine oil engines, each of 1,200 indicated horsepower.

The engines of this vessel successfully burn the same heavy grade of fuel oil (of from 14 to 16 Baumé gravity) that is ordinarily burned under boilers. The daily fuel consumption of the *Kennecott* is 55 barrels, driving the ship at a sea speed of over ten knots. This is equivalent to only 10 gallons of oil required to drive the ship one nautical mile. The engine room staff consists of eight men.

An interesting engineering feature is that all the auxiliary machinery on this ship is electrically driven. The winches for handling the cargo, as well as the anchor windlass, the capstan and the steering gear, are all driven by electric motors, the current for which is furnished by two McIntosh & Seymour engines, each of 100 horsepower driving a General Electric generator.

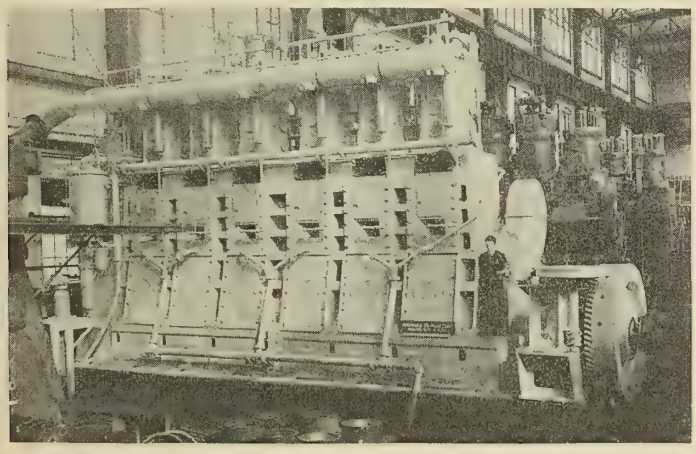


Fig. 1.—One of the Kennecott's 1,200 Horsepower Diesel Engines

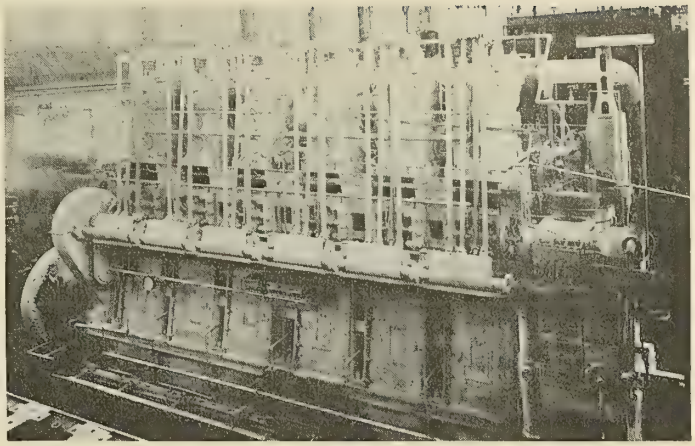


Fig. 2.—View of the Engine, Showing Valve Gear

A lesson to be learned from this vessel is that she requires less than half the quantity of fuel oil burned under the boilers to generate steam in a turbine or reciprocating engine driven ship, and furthermore, requires a less number in the engineer crew than is needed on a vessel of the same size, steam driven.

Chuck for Holding Broken Drill Shanks

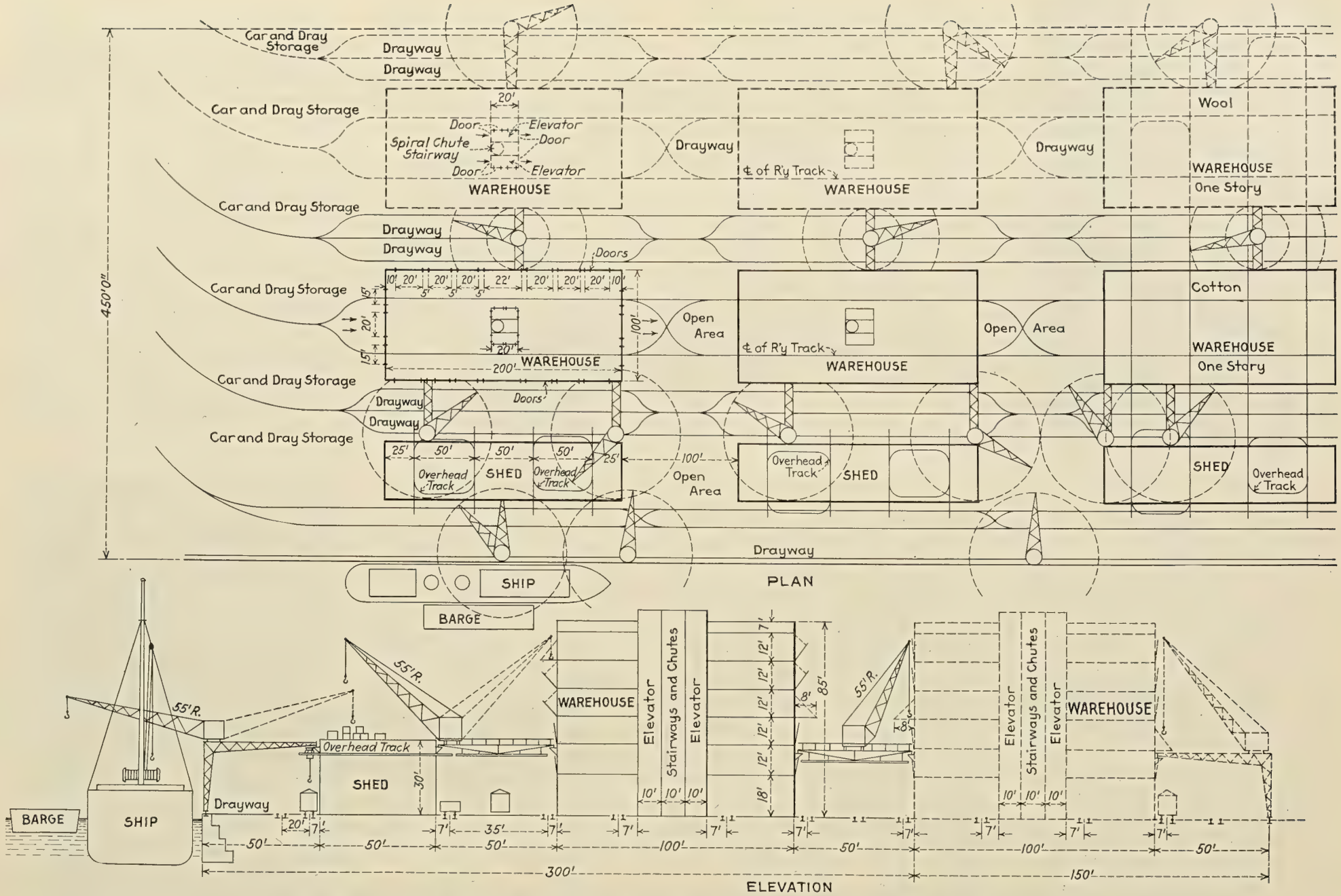
In reducing the small tool equipment expense in shops where twist drills are used in large quantities, a new chuck produced by the Wayne Tool Manufacturing Company, Waynesboro, Pa., for holding drills which have been broken at the shank will be found quite useful.

Chuck Designed for Broken Drill Shanks

The chuck is of a simplified design, consisting of but six parts: a shank, the chuck casing, two pawls, two screws, and a casing plate. Drills formerly discarded when broken may be ground to a 60 degree point at the broken end, which permits this end to automatically center itself in a corresponding 60 degree recess in the shank of the chuck. By turning the casing the pawls are brought into action and grip the drill above the grooves, thus locking it securely in the chuck. No wrenches are required to tighten or release the chuck, the hand twist of the casing alone being sufficient to cause a positive grip of the pawls on the drill end.

Industrial Research Laboratories

RESEARCH facilities and the development activities of American industries are to be described in the forthcoming revision of *Bulletin of the National Research Council* Number 2, "Research laboratories in industrial establishments of the United States of America." Only 300 such laboratories were listed in the first edition but it is hoped that several hundred new names will appear in the revision and that a more nearly complete reference list will thus become available. The Council requests particulars of their staff, equipment and facilities from directors of research who have not already supplied it. This material should be furnished as promptly as possible to the Research Information Service, National Research Council, 1701 Massachusetts avenue, Washington, D. C. The general demand for the first edition of the Bulletin shows the wide interest in this subject and the importance of having every laboratory which devotes even a portion of its time to research properly listed.



Plan and Elevation, Showing Arrangement of Sheds, Warehouses and Approaches of Quay Terminal

Quay Steamship Terminal Design

Plan by Which Great Speed Can Be Attained in Handling Freight at Quay Terminal

By H. McL. Harding*

ONE unit area of a quay terminal may be said to comprise a waterfront length of 300 feet and a width of 150 feet or 300 feet. The 300-foot width would include warehouse and approaches.

Of this 300 feet unit length from left to right the first 50 feet as shown in the plan is for rail and dray approaches and for open storage; the next 200 feet is occupied by the transit shed with its front wall at a distance of 50 feet from the water's edge, and the remaining 50 feet is reserved for additional rail, dray approaches and storage. Fifty feet + 4 (50 feet) + 50 feet = 300 feet.

The 300 feet of width is reserved as follows:

The first 50 feet from the outer edge of the quay wall to the shed is for railway tracks and for drayways, chiefly for outbound freight; the next 50 feet is for the shed; the third 50 feet is for railway tracks and drayways, chiefly for inbound freight; then 100 feet is for the warehouse location and the next 50 feet for railway tracks and drayways. Fifty feet + 50 feet + 50 feet + 2 (50 feet) + 50 feet = 300 feet.

Another unit of 300 feet would be similar to the first unit. Originally it was the custom to make the shed and warehouses each 400 feet long, but the necessity of greater drayways and less length of detours to the waterfront rendered the changes necessary. The one unit of 300 feet is generally of ample length for river barges. Two units each of 300 feet, that is 600 feet, would be required for ocean ships.

The shed is 200 feet long and 50 feet wide and the warehouse 200 feet long and twice 50 feet, or 100 feet, wide; the distance from the warehouse to the ends of the unit is 50 feet.

This use of 50 feet as a measure will enable all dimensions to be easily remembered. All plan distances are 50 feet or multiples of 50 feet. There are two railway tracks in front of the shed and three railway tracks in front of the warehouse, that is between the shed and the warehouse, three tracks to the rear of the warehouse. There are also two railway tracks within the warehouse. Of the three tracks to the front and rear of the warehouse the center tracks are for switch connections. The various tracks as shown are connected by crossovers.

All external tracks and drayways in front of and between the buildings are spanned by traveling bridge cranes. These bridge cranes sustain foot bridges, monorails with hoists and revolving derricking jib cranes, all of which travel with the cranes. Attached to the derricking jib cranes are in addition the usual types of whip hoists. Within the warehouse in the center are two elevators with 20-foot by 10-foot platforms. Between the two elevators are spiral chutes and stairways. Motor drays are becoming larger.

The drays or tractors and trailers enter at one end of the warehouse on the ground or first floor and pass upon the platform of either of the elevators. In leaving they depart through the doors at the other ends of the elevators.

At the ground floor besides the doors at the end of the elevators, there are doors at the sides whereby freight can be unloaded from cars directly upon the elevator platforms or from the elevators through the same openings into or upon the cars. Should there be a basement of the warehouse, one of the elevators would have one of its shafts extended into the basement.

* Terminal Engineer, New York, former president, Society of Terminal Engineers.

It will be noticed that the average distance from the elevators to any part of a floor is about 60 feet. It is therefore obvious that considering the fact that warehouse freight may not be moved for several months, and also the short distances of the average freight movements, little horizontal transferring machinery will be required.

The movement, however, to and from the different floors of the warehouse, that is, the hoisting and lowering as well as the approach movements to the warehouses, should be with great speed and without congestion.

The second unit in line with the first is similar. Therefore there are 100 feet between the ends of two sheds and 100 feet between the warehouses.

On account of the fire risk it is necessary to have these buildings separated. The fire risk is far greater in the shed than in the warehouse and the two should be separated. The shed is of steel but the warehouse is of reinforced concrete.

Should there be a second line of warehouses they will be parallel to the first line. To the rear of the last line of warehouses is a traveling bridge crane, the same as the first with the outer end of the bridge crane supported on rails on a steel trestle.

Conclusions

First: From six external parallel railway tracks, three on each side of the warehouse, freight can be transferred to or from any of the six floors of the warehouse, serving about 60 cars.

Second: From two dray areas each 50 feet in width and about 400 feet in length drays can be similarly served.

Third: From cars on two internal parallel railway tracks, freight may be directly delivered to or taken from elevator platforms.

Fourth: Drays on the ground floor can enter or leave large elevator platforms for any floor of the warehouse.

Fifth: For certain classes of freight spiral chutes can be advantageously utilized.

Sixth: The latest type of warehouse is the one space type with only one floor, that is the ground floor, and with a clear height of 50 feet. Such a warehouse is for cargoes of few consignments, as bags of coffee, rice and sugar, bales of cotton and wool, boxes of lemons and oranges, boxes of tea, cases of dry goods and barrels of liquids. There are also the combined warehouses—part being of multi floors and the rest of one floor. The cost of the one story warehouse equal in capacity to the five story is about one-fifth; the operating expense is about one-third, and the time for transferring and handling about one-fourth. The one story type may be said to be derived from the high studded terminal shed.

Measuring the Salinity of Boiler Water

A METHOD of measuring the salinity of boiler water and incidentally of surface condenser leakage by means of the variations of resistance offered to the flow of an electric current through water of varying degrees of salt concentration has been developed by the Leeds & Northrup Company, Philadelphia, Pa. The method, briefly stated, consists of providing for a continuous flow of the condensates and boiler waters around suitable electrodes

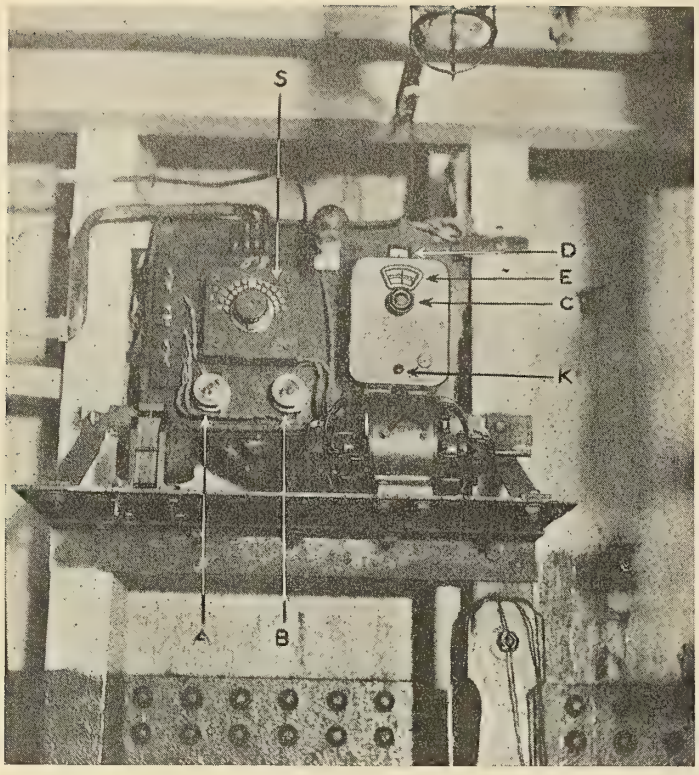


Fig. 1.—Measuring Apparatus as Installed in Engine Room of Cargo Vessel

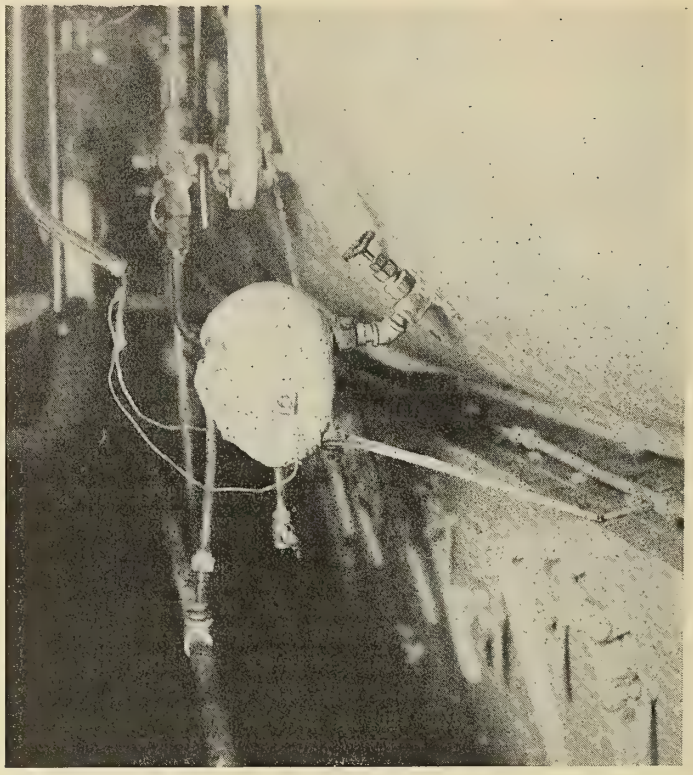


Fig. 2.—Boiler Water Cell Installed on Babcock & Wilcox Marine Boiler

arranged in pairs. The resistance offered to the flow of electric current between each set of electrodes is then measured with a Wheatstone bridge. A selector switch is provided for connecting the measuring apparatus to any one of the pairs of electrodes in the various condensates and boiler waters.

Fig. 1 shows the measuring apparatus as installed in the engine room of a cargo vessel. When in operation, switches

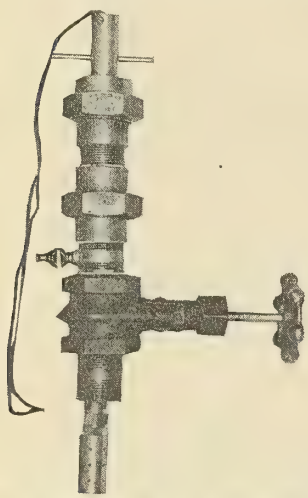


Fig. 3.—Cell for Measuring Salinity of Condensate

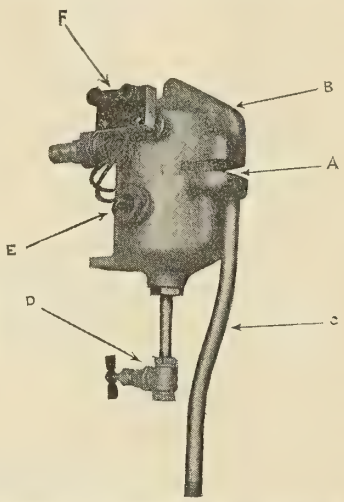


Fig. 4.—Cell for Insertion in Condensate Pipe Line

A and *B* are closed and the selector switch *S* turned to the position corresponding to the boiler in which the salinity is to be determined. The circuit is then closed and knob *C* adjusted until the galvanometer pointer *D* comes to rest at zero. Then the salinity may be read directly from the dial *E* in grains of chlorine per gallon. By adjustment of the selector switch the salinity in any other boiler may be determined. Fig. 2 shows a photograph of the boiler water cell installed on the Babcock & Wilcox marine boiler.

Fig. 3 shows the installation of the cell for measuring the salinity of the condensate. Two electrodes are mounted in a perforated case at the end of a brass tube. The lead wires are brought out at the other end through a rubber bushing The tube is then inserted vertically inside the outer tube to a depth sufficient to place the electrodes beneath the level of the water in the filter box.

Fig. 4 shows a smaller cell equipped for insertion in a condensate pipe line. The cell tube is mounted in the form of a gate valve, ground union and stuffing box in such a manner that the cell may be withdrawn and inspected without leakage of the condensate or interruption of service from the turbines.

Reciprocating and Turbine Pump Governors

NEW designs of constant pressure and variable pressure "Ideal" marine pump governors have been made by the engineering staff of the Atlas Valve Company, Newark, N. J. In former designs of this governor, a gooseneck containing an oil trap was used. In both the new types this gooseneck oil trap has been eliminated, the trap being cast into the body of the governor itself, thus reducing the number of parts and eliminating the danger of leakage. The method of feeding oil to the oil bath has been much simplified. In the case of the constant pressure type governor, one stuffing box on the top has been removed.

In general the governor consists of two moving parts, a steam valve which slides backward and forward within a valve body of the double balanced valve type, and a control piston which moves backward and forward in a bath of oil within the control cylinder. This oil bath serves to lubricate the operating piston and also to prevent the liquid being pumped from entering the control cylinder. It also eliminates the possibility of the piston sticking due to corrosion or sediment. The variable pressure type governor is equipped with an emergency control lever which provides a means for manually operating the governor so that it can be held wide open or shut off tight regardless of the pump pressure.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department

Conducted by James L. Bates

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Wind Resistance of Vessel's Topside and Superstructure Surfaces

Q. (1126).—Please advise as to the effect of great topside and superstructure areas upon the performance of large oceangoing vessels.

A. (1126).—This effect is manifested in several ways, each being more or less apparent as the causes to which it is attributable are present in greater or less degree in a given case. If it be assumed that the vessel has sufficient stability in all conditions, the question of the effect of the vertical distribution of the weight involved may be dismissed at once.

It then becomes necessary to consider the effect of the wind, induced or not by the vessel's speed, upon the ship. This may be manifested in the effect upon steering when under way, in the position assumed when riding to a mooring, in the effect upon the vessel's position relative to the vertical when at sea, in a tendency to drift to leeward under the action of a beam wind and in decreased speed when steaming into head winds.

Large vessels usually operate on a fixed schedule and make straight runs between ports so that maneuvering is not important. Provided the distribution of both topside and immersed surface fore and aft is reasonably symmetrical, steering characteristics should be satisfactory. High structures and light draft forward combine to make it difficult to keep a course with a wind from either bow. In this connection, note the losses which have sometimes occurred among the Great Lakes freighters after a heavy storm. These vessels have machinery aft and, when light, trim deeply by the stern. They are then difficult to control in a heavy blow.

Such an arrangement of superstructure as referred to above results in yawing when moored by the bow. This is objectionable because of the probable loss of ground tackle and the danger resulting to both the vessel itself and to other vessels anchored near by.

In considering a vessel's behavior under the action of a beam wind, we have a condition somewhat analogous to that of the sailing ship. The drift to leeward, other things being equal, will depend upon the ratio of the area of topside to that of the immersed lateral plane. When the value of this ratio exceeds about 2.25 we may expect some difficulties in handling, due to the small hold of the ship upon the water and the large hold of the wind on the ship. If, in addition to the above, the vessel in hand has been given a small value of metacentric height in order to secure easy motion in a seaway, we may expect her to assume and maintain uncomfortably large angles of heel for such periods of time as the wind may continue to act.

The retarding effect of head wind upon a high speed vessel with lofty upper works may be very pronounced. Experiments carried out upon the model of the *Mauretania* indicate that with a head wind equal to the maximum ahead speed of the vessel, about 25 knots (the velocity of the wind relative to that of the ship thus being 50 knots), an increase of 12 percent over the resistance of smooth water at maximum speed might be anticipated.

The following table shows some interesting values of rudder area ratios and ratios of areas of topside to areas of immersed planes for several large vessels:

	Length B. P., Feet	Draft, Feet	Freeboard For'd, Feet	Freeboard Aft, Feet	Ratio: Topside area to area of central immersed plane	Ratio: Area of central plane to rudder area
Leviathan	907.5	38	52	37	2.0	90
Aquitania	865	36	48	38	1.95	75
Olympic	850	34.5	50	42	1.88	50
Collier, loaded	520	28.0	29	24	.86	65
Collier, light	520	16.0	45	31	2.26	114

The above figures are not taken from the detailed plans but are believed to be sufficiently close for the purpose in hand. Deck houses and stacks have been included in obtaining the projected area of the above water portion. Masts, boats, etc., have been omitted.

The collier, when light, not only has a high topside ratio but the freeboard forward is relatively very great. In service some difficulty has been experienced in handling her. This has necessitated special ballast arrangements and the fitting of the present relatively large rudder.

Speed of Ship and Revolutions of Propeller

Q. (1129).—I would appreciate knowing the rule or formula for figuring the miles per hour made by an ocean steamer by using the following data from the engineer's log:

4.00 P. M.	86770			R. P. M.
5.00 P. M.	92750	5980	60	99.6

The officer of the watch would read the patent log at 5.00 P.M. and get his miles per hour as, say 10.8. If he wanted to check the distance run by using the revolutions per minute or the revolutions per hour from the engine room counter, how would he go about it from the above data?

If the chief engineer told him that the "slip of the propeller" was 15 percent for that particular ship, in what manner would it enter the calculation?

A. (1129).—There is no formula by means of which the speed of a vessel may be accurately ascertained, having given only the revolutions of the screw. In his book, "Practical Marine Engineering," Seventh Edition, pages 593 to 602, Admiral Dyson gives a brief discussion of the principles involved in the problem of propulsion. A careful study of these pages will be of value.

In order to find the speed of a ship, the following data are required:

The pitch of the propeller, expressed in feet—p.
The revolutions of the propeller per minute—R.
The slip ratio or slip, expressed as a percentage—s.
The procedure is then as follows:
(a) Multiply the pitch by the revolutions.
(b) Subtract the slip percent from 1.00.
(c) Multiply together the results from (a) and (b).
(d) Divide the result in (c) by 101.3.

If V represents the speed of the ship in knots, we may express the foregoing as follows:

$$V = \frac{pR\,(1.00 - s)}{101.3}$$

It will be noted that the above method depends for the accuracy of its results upon an exact knowledge of the pitch of the propeller and the slip (the revolutions being taken from the counter as stipulated).

As made and installed propellers are subject to variations in pitch in a given blade and in the different blades of the same propeller. In actual service, the ship herself will vary from time to time as to displacement, trim, condition of bottom. Further, the hub of the propeller and the after body of the vessel itself may be so designed as to cause abnormal eddy losses. The propellers may also be so located with reference to the hull as to work inefficiently. It will accordingly be apparent that neither the pitch of the propeller nor its slip is susceptible of accurate determination from the design data and that even with the greatest care, their measurement from the actual vessel can be closely accurate for only a given set of conditions.

The most satisfactory method of relating revolutions and speed of ship for convenient reference is by means of curves of speed and revolutions. The data from which these are plotted are obtained from standardization trials, made over a carefully measured course, under favorable conditions of weather and bottom and at known displacements. Such curves, of course, take into consideration pitch and slip and, if carefully prepared, are substantially accurate for the conditions obtaining at the time of the trials.

Characteristics of Curve of Transverse Metacenters

Q. (1130).—Is it possible for a curve of transverse metacenters to drop as the lower drafts are approached? If so, what is the cause and is a form which gives a curve having such a characteristic a desirable one?

A. (1130).—Such a curve is easily possible, though it is seldom met in large steam vessels of the present day.

The cause is to be found in the relationship which the height of metacenter bears to the form and displacement of the vessel. The position of the metacenter in any floating vessel is determined by the value of the *B. M.* (that is the distance between the vertical center of buoyancy and the metacenter) and the vertical height of the center of buoyancy. This relationship may be expressed thus:

$$M = V.\,C.\,B. + B.\,M.$$

In which M is the height of the metacenter from a fixed reference line, as the bottom of keel or the load water plane. $V.\,C.\,B.$ is the height of the center of buoyancy relative to the reference line. $B.\,M.$ has been defined above.

$$\text{Now } V.\,C.\,B. = \frac{\text{moment of volumetric displacement about reference line}}{\text{volume of displacement}}$$

$$\text{and } B.\,M. = \frac{\text{moment of inertia of water plane}}{\text{volume of displacement}}$$

The transverse immersed sections of the modern steam vessel approach rectangles throughout the length of the vessel's middle body which generally accounts for the greater portion of her displacement. These sections in some modern destroyers, in certain tugs and in many cruising yachts propelled by sail approach more nearly the triangle. If we conceive two vessels, one having a constant rectangular cross section from end to end and the other having a constant triangular cross section from end to end, a study of the transverse metacentric curve of each will aid in bringing out the differences and the reasons therefor (see Figs. 1, 2 and 3).

In Figs. 1 and 2 the waterlines are numbered 1, 2, 3, 4, 5. In Fig. 3 the ordinates indicate the number of units above the base while the abscissas correspond to the waterlines.

Note that the curves of $V.\,C.\,B.$ are similar in shape and that for Fig. 1 is the higher. The curves of metacenters are entirely dissimilar, that for Fig. 2 having a low point between waterlines 3 and 4, rising gradually from this point to the upper waterlines but increasing in height rapidly toward the lower waterlines. For Fig. 1 the curve of metacenters is a straight line. The differences between the two curves are largely due to differences in the values of *B. M.* (the value of *B. M.* at any point being the vertical distance between the curve of metacenters and that of the center of buoyancy).

In general, then, it may be said that vessels with flat floors have curves of transverse metacenters which rise rapidly at the lighter drafts because the volumes of displacement decrease much more rapidly than the inertia of water plane.

Vessels with great rise of floor have curves of transverse metacenters that drop rapidly at the lighter drafts because the volumes of displacement decrease more slowly than the inertia of water plane.

The form of cross section appropriate to a given type of vessel is generally fixed by considerations of cargo capacity, resistance, behavior in a seaway, etc., and the beam is fixed at a figure such that a proper value of metacentric height will result. It may be said, accordingly, that the form of metacenter curve is a minor consideration in the choice of shape of cross section.

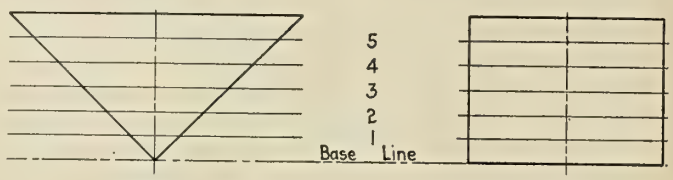


FIG. 1. FIG. 2.

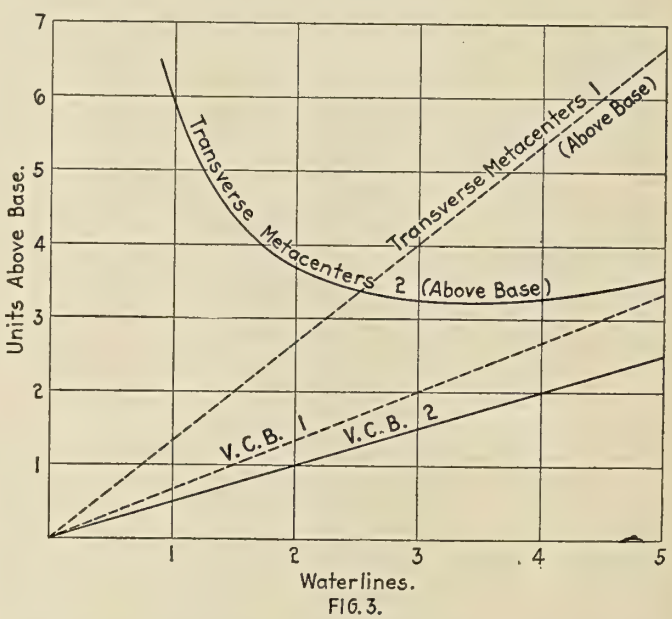


FIG. 3.

SIR JOHN HARVARD BILES is shortly retiring from his position as third occupant of the John Elder Chair of Naval Architecture and Marine Engineering at the Glasgow University, which position he has held since 1891. Professor Biles is a well known architect and has been for a long time identified with the Clydebank Shipbuilding Works, where he did original work in designing, notably the Atlantic liners, the S. S. *Paris* and the S. S. *New York*, the Russian destroyer *El Destructor* and the Spanish cruiser *Reina Rienta*. Professor Biles acts as consulting naval architect to the India office, is a past master of the Worshipful Company of Shipwrights and has been president of a number of professional and scientific societies. He has also published many works on naval architecture and marine engineering.

PERSONAL MENTION

A. J. Frey, a practical ship operator of twenty years' experience, has been appointed one of the three vice presidents of the Emergency Fleet Corporation who will be on the board directing the Shipping Board fleet. For sixteen years previous to 1918 he was with the Pacific Mail Steamship Company for the last eight years of which term he was assistant general manager. In May, 1918, he joined the forces of the United States Shipping Board Emergency Fleet Corporation, at San Francisco, and thereafter succeeded district manager Pillsbury, in charge of the Ship Construction Division of the Southern Pacific District. This position he held until July, 1920, when he entered the employ of the Los Angeles Steamship Company as general manager of that concern, operating passenger vessels between San Francisco and Los Angeles, a position which he resigned in order to come with the Shipping Board. Mr. Frey is 43 years of age, and is regarded by practical shipping men as an exceedingly competent executive, thoroughly familiar with ship construction and operations. While with the Pacific Mail Steamship Company Mr. Frey managed the operation of the largest fleet of steamships plying between the Pacific Coast and Oriental ports. His record with the Shipping Board has been unexcelled.

A. J. Frey

William J. Love of Furness, Withy & Company, Ltd., has been appointed one of the three vice presidents of the Emergency Fleet Corporation who will be on the board directing the Shipping Board fleet. Mr. Love was born in Baltimore in 1873. He is the son of Colonel William H. Love, who is an authority on the history of Maryland and early American shipping. He was educated at St. Martin's Academy and subsequently prepared for the Naval Academy, but decided to enter the employ of Christopher Furness, who ran lines of steamers from Baltimore and Newport News to the United Kingdom. After two years' experience he entered the employ of the Atlantic Transport Company, Baltimore, and remained with this company until 1917, passing through the various departments, becoming manager of the American flag steamers of the International Mercantile Marine Company. Later he resigned to become the assistant manager in the United States for Furness, Withy & Company, Ltd., one of the largest shipping firms of Great Britain. During the war Mr. Love was the Director of Trades and Allocations under the Shipping Control Committee, and for a time acted as advisor to the Chief of Embarkation, under General Goethals. Following the armistice, Mr. Love returned to New York, re-entering the employ of his former firm as assistant manager in the United States. Mr. Love's experience has been exceedingly comprehensive, covering every aspect of the entire shipping world. He is especially familiar with competitive trade conditions throughout the world, and likewise has a large acquaintanceship with the merchants and exporters throughout the United States. His expert knowledge and acquaintanceship will be invaluable to him in the performance of the duties he has undertaken in connection with the operation of the fleet.

Wm. J. Love

J. Barston Smull, of J. H. Winchester & Company, has been appointed one of the three vice presidents of the Emergency Fleet Corporation who will be on the board directing the Shipping Board fleet. Mr. Smull was born in the City of New York in 1874. His parents were Baltimorians. He was educated in the Harvard School, New York, and afterwards at Columbia College. He later entered his father's shipping business in 1894, and in 1907 he joined the firm of J. H. Winchester & Company, steamship agents and ship brokers, which firm was incorporated in 1913, when he became vice president of that corporation. The firm of J. H. Winchester & Company was established back in 1856 and is now the largest ship brokerage company in America. Mr. Smull has been closely identified with the work of the New York Produce Exchange and has been on the Board of Management the last six years, and for the last two years has been vice president of the New York Produce Exchange. He is also chairman of the Committee on Harbors and Shipping of the Chamber of Commerce in the State of New York and serves on the executive committee of that organization. During the war Mr. Smull was associated with the Shipping Board as a member of the Chartering Committee which functioned at New York. This committee had to pass on all the charters for all steamers—whether American or foreign flag—which sailed from or to an American port. During the war period that committee passed on upwards of 20,000 charter parties. Mr. Smull has had a wide experience in all branches of shipping and is thoroughly familiar with all questions in connection therewith, as well as with questions of trade routes, etc. He is recognized by all shipping interests as a foremost expert in ship operation, including trans-oceanic and coastwise.

J. B. Smull

Isaac Harter has been appointed general superintendent of the Babcock & Wilcox Company, New York, to succeed the late James P. Sneddon. Mr. Harter was born in Mansfield, Ohio, in 1880, and was educated in St. Paul's School, Concord, N. H., and the University of Pennsylvania. Immediately upon graduation in 1901 from the latter institution, he entered the employ of the Aultman & Taylor Machinery Company, a corporation of which his father had previously been president. He began at the bottom in the boiler department as a gang boss on inventories, and was transferred later to the cost department, where he became familiar with the details of each branch of the business. He was elected a director of the company while in this department, and a little later was appointed acting superintendent of the boiler department. In September, 1905, the company sold its boiler

business to the Stirling Company, and Mr. Harter joined the staff of E. R. Stettinius, the business head of the latter company, which was absorbed by the Babcock & Wilcox Company in 1907. When L. I. Summers resigned the position of superintendent of the Stirling works at Barberton, Mr. Harter succeeded him, and in 1911 became superintendent of the Bayonne works. He served in this capacity until about a year ago, when he became assistant to the president, at New York, where his office will remain as general superintendent.

JUDGE WALTER D. MEALS, former associate justice of the Appellate Court of Ohio, has been appointed chairman of the United States Shipping Board Claims Commission, which is to settle all unliquidated claims, amounting to $211,000,000, which the new Shipping Board has inherited. The associate members of the commission are Homer Ferguson, president of the Newport News Shipbuilding & Dry Dock Company; F. W. Wood, former president of the Maryland Steel Company; Captain Richard M. Watt, Construction Corps, United States Navy; and Arthur W. Teele, of the accountant firm of Patterson, Teele & Dennis. The secretary of the commission will be O. P. M. Brown. The commission will probably not begin active functioning until September 1, as the new Shipping Board will require that length of time to get its cases ready. In the meantime, the commission will send notices and forms to all claimants so as to expedite the findings of the commission, once it is in session.

LETTERS TO THE EDITOR

Superheated Steam on Steamships

In connection with the article by Dr. Peabody in the July issue of *Marine Engineering*, I would like to draw attention to a few points in connection with the form in which data are frequently presented to show comparative performances of superheated and saturated steam installations. The data given by Dr. Peabody on page 541 show clearly the fuel saving effected by using superheat on two tow boats, but the article gives insufficient information for the use of a designer who is trying to gather data for use in proportioning new installations.

The thing that is almost always lacking in the information published about performances with superheated steam is the boiler data.

There are two main divisions of the steam plant which can behave more or less independently to either raise or lower the over-all plant efficiency, namely, the boiler and the main engine or turbine. To compare the saving due to superheat for two ships or for the same ship with and without superheat, without giving the relative boiler and engine efficiency in each case, does not benefit the designer very much.

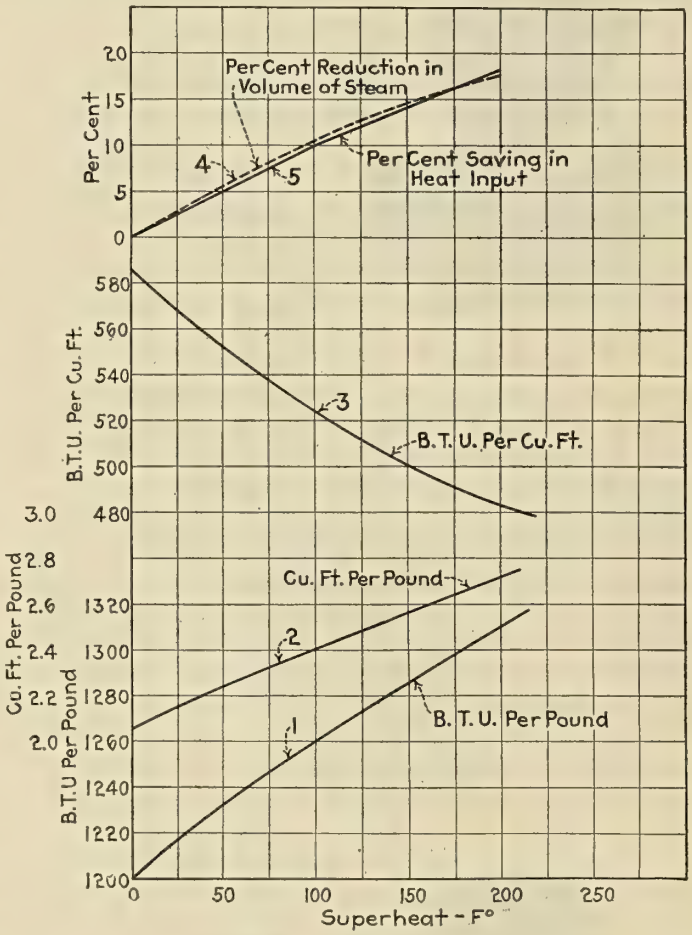
It is a characteristic of boilers that the efficiency is increased if the normal evaporation per square foot is reduced. In cases where a ship is converted from saturated to superheated steam, due to the lower engine water rate, the steam flow will be reduced and with the same boilers the required evaporation is reduced so the boiler efficiency will be increased. Therefore, in such a case, the saving due to superheat is due to higher boiler efficiency as well as higher engine efficiency.

Where useful data are to be published regarding fuel saving with superheat, it would be an advantage to the reader (since the boiler efficiency and engine water rate are probably not known), if the type of boiler and total heating surface were given.

In connection with the increased efficiency of the reciprocating engine due to the use of superheat, we may naturally expect considerable variation for different designs, but the different text books and technical magazines seem to average up about the same in giving one percent gain for every ten degrees of superheat from 0 degree up to 100 degrees and one percent for every twelve degrees from 100 degrees to 200 degrees.

It is generally considered necessary in order for an engine to develop the same mean effective pressure with superheated as with saturated steam, to increase the high pressure cutoff. This view is not at all consistent with the generally supposed economy gain due to superheat as is shown by the attached curve sheet.

Curves 1 and 2 are plotted from the values in Marks and Davis' tables for steam at 225 pounds per square inch absolute. Curve 3 is obtained by dividing 1 by 2. Curve 4 represents the percent reduction in ordinates of curve 3 based on



Properties of Superheated Steam

B.T.U. per cubic foot for saturated steam. Curve 5 is the increase in efficiency based on one percent per 10 degrees up to 100 degrees superheat and one percent per 12 degrees from 100 to 200 degrees superheat.

The practical coincidence of curves 4 and 5 shows that if the actual saving in steam due to superheating is as great as curve 5 indicates then an engine will give the same power for the same high pressure cutoff regardless of superheat. On the other hand, when experience shows that the volume of steam supplied to an engine has to be substantially increased for the same power using superheat then the increase in efficiency is not as great as curve 5 shows.

For any other boiler pressure a similar set of curves can be deduced and the conclusion to be derived will be the same as we have shown for the case of 225 pounds per square inch absolute.

It seems to the writer that there is a very broad field for valuable investigation in the matter of superheating. We need much more reliable data than we now have for the ratings and efficiencies of marine boilers and engines using superheat.

Newark, N. J. JAMES L. HAYNES.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements —Engineering Projects—Improved Appliances

Marine Societies Combine to Hold Big Exposition in New York During Third Week of November

First Annual Exhibit Will Be Held in Central Mercantile Building—"American Marine Week" Promises to Be Epoch-Making Occasion—List of Committee Members

At a meeting of the Executive Committee of the Marine Equipment Association of America, held in the office of the president, Col. Edward A. Simmons, Woolworth Building, New York City, on July 21, it was decided to hold the first annual exhibit at the Central Mercantile Building, New York City, during the week beginning November 14, next.

The Central Mercantile Building, more familiarly known as the Greenhut Building, is located on the east side of Sixth Avenue, between 18th and 19th Streets. For some years it was occupied by a retail dry goods store and during the war was taken over by the War Department and used as a hospital for sick and wounded soldiers returned from overseas. Each floor of the building contains more than 80,000 square feet of space with a floor load of 190 pounds per square foot. The first two floors have been laid out by the Manufacturers' Exhibition Company, Inc., for permanent exhibits of machinery and mechanical appliances much like the one that has existed in the Bourse Building, Philadelphia, for several years. The marine show will be held on the third floor; and all exhibits will be installed under the direction of the Exhibits Committee of the association, of which W. M. Wampler, of the Coen Company, is chairman. Applications for space as well as for membership in the association should be addressed to the secretary, K. L. Ames, Jr., American Steel Foundries, McCormick Building, Chicago, Ill.

The by-laws of the association provide that only members may exhibit. The annual dues are $25 a year; and each exhibiting member will be charged a given price per square foot for such space as he may contract. The cost for this year has not yet been determined.

It is the plan of the association to lay out the exhibit spaces in given standard units of uniform design, which may be easily put up, taken down and stored, and to buy and own all of the material for use in future years.

The action of the Marine Equipment Association in deciding to exhibit during the week in which the Society of Naval Architects and Marine Engineers will hold its annual convention and the appointment by the Council of that society of a committee consisting of Captain C. A. McAllister, chairman, J. Howland Gardner, W. H. Todd, H. H. Raymond and F. L. DuBosque to act with a like committee of the Marine Equipment Association in laying out a joint program for a big "American Marine Week," will mean much to the shipbuilding industry of this country directly, and will also stimulate public interest in the American merchant marine. Also, the American Society of Marine Draftsmen has changed the date of its annual meeting to November 14 and it is believed that other organizations in the marine field will decide to meet during that week.

The members of the executive committee are: New England District: E. B. Williams, manager marine department, B. F. Sturtevant Company, Boston, Mass., and F. L. Andrews, vice-president, Hyde Windlass Company, Bath, Me. New York and New Jersey District: M. L. Katzenstein, manager marine department, Worthington Pump & Machinery Corporation, New York; W. M. McFarland, manager marine department, Babcock & Wilcox Company, New York; H. C. Davis, treasurer, Row & Davis Engineers, Inc., New York, and Frank Hatch, vice-president, Shepard Electric Crane & Hoist Company, Montour Falls, New York. Pennsylvania, Maryland, Delaware, District of Columbia, Virginia and West Virginia District: G. W. Selby, secretary-treasurer, Marine Decking & Supply Company, Philadelphia, Pa.; J. C. McQuiston, director of publicity, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; William Stayton, president, Baltimore Steamship Company, Baltimore, Md., and W. P. Smith, superintendent of sales, Wm. Cramp & Sons Ship & Engine Building Company, Philadelphia. South Atlantic and Gulf States District: Paul Jahncke, vice-president, Jahncke Dry Docks & Shipbuilding Company, New Orleans, La. Great Lakes District: F. C. Bradbury, manager marine department, Crane Company, Chicago; J. D. Sarles, manager marine department, Pyle-National Company, Chicago; H. L. Hibbard, manager marine department, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; and J. H. Redhead, assistant manager of sales, National Malleable Castings Company, Cleveland, Ohio. Pacific Coast District: W. M. Wampler of the Coen Company, San Francisco, and H. F. Alexander, president of the Pacific Steamship Company, Seattle.

The Finance Committee consists of W. M. McFarland, Babcock & Wilcox Company, chairman, and J. R. Tiebout, Jr., of W. & J. Tiebout.

SUCCESSFUL TRIP

Steamship "George Washington" Satisfactory on Trials

On Saturday, July 16, the *George Washington* sailed for Boston for the double purpose of dry docking—New York not having a dock large enough—and trying out her machinery and equipment. She carried on this trip a total of 650 persons divided as follows: crew, 414; mechanics and watchmen, 193; shipping men and representatives of the Shipping Board, United States Mail Steamship Company and manufacturers of marine equipment, 43.

On the way up the time was devoted to checking and adjusting the compasses, rudder indicators, annunciators and all the equipment used in working the ship. Although full speed trials were not attempted on this leg on account of the condition of the vessel's bottom, her engines were well tested for various combinations of maneuvering power such as going ahead with one engine while reversing with the other.

Upon her arrival at Boston on Monday morning she immediately entered the 1,200 foot Commonwealth Dry Dock where a train of pontoons was quickly arranged along her sides so that the workmen could start scraping her underbody as the water was being pumped out of the dock. She was cleaned and painted before three o'clock Tuesday, when she was again floated and ready to proceed on her return trip.

After passing Boston Light on her way back the engines were turned up to full speed, turning over at 82 revolutions per minute, which corresponds to a speed of 18½ knots. The ship was kept at practically full speed for the entire return trip, showing that the machinery is in excellent working order. Very little vibration is noticeable at full speed, but around 11 or 12 knots there is a point where there is considerable vibration.

The stewards' department was also under trial, having to care for 650 men, and we are glad to say that the service and food compared favorably with those of the old established lines.

The *George Washington* will be in excellent shape for her initial trip on August 3, as the reconditioning work is now practically complete. She will take 250 members of the American Legion to France on this voyage, where they will be the guests of the French Government. They will be royally entertained for seventeen days.

"Archer" and "Independence," Electrically Driven, On Sea Trials

Sea trials for two electrically driven ships were run off by the new trial board of the United States Shipping Board outside of Sandy Hook, N. J., when the newly converted ships *Archer* and *Independence* were given their official tests on July 21 and 14, respectively. Commander V. V. Woodward is chairman of the recently named trial board, the other members being H. B. Taylor, chief turbine engineer; A. K. Nichols, local Shipping Board manager at Philadelphia, and A. Conti, manager of the technical department at New York. In the absence of other members of the board on various assignments, the two electric drive trials were conducted by Chief Turbine Engineer Taylor. Both trials were announced as being highly successful.

Both ships are of 11,868 deadweight tons, 440 feet in length, and were built by the Bethlehem Shipbuilding Corporation on the west coast. The General Electric Company supplied the electrical equipments, the installations being by the Tebo Yacht Basin Company, Brooklyn, N. Y., one of the Todd Shipyards Corporation plants.

The results of the trials of the *Archer,* which was commanded by Captain F. A. Branen, were coincident with those of the *Independence,* Captain Crozier.

"Everything proved entirely satisfactory," Mr. Taylor said upon the return of the *Archer.* "The electric drive mechanisms and all the auxiliaries functioned perfectly and the trial was one of the most successful we have ever run. The propeller developed between 100 and 102 revolutions per minute, giving the ship a speed of about 11 knots. She carried and maintained easily between 200 and 210 degrees of superheat."

In addition to a large number of shipping men, naval architects and engineers attending both trials, representatives were on board from the General Electric Company, the Superheater Company, White Fuel Oil Engineering Corporation, Wilson & Monahan, Diamond Power Specialty Company, Chadburn Ship Telegraph Company of America, American Navigator Log Corporation, the American Bureau of Shipping, and the Todd Shipyards Corporation.

The *Archer* and *Independence* are sister ships of the *Eclipse* and *Invincible,* which have already made successful voyages as electrically propelled cargo carriers. In each case the electric equipment has been installed under the supervision of the Shipping Board.

Independence Completing Trials

NEW FERRIES

New York to Spend Close to Half Million on Boat Lines

With a total of $995,000 expected to be made available in the immediate future—$695,000 for the Grand Street Ferry Line and $300,000 for the Dyckman Street Terminal—the Department of Plant and Structures of the City of New York will probably spend close to half a million dollars for boats, terminals and equipment, according to official information obtained by MARINE ENGINEERING. In addition, the department carried on the work of blowing up the sunken ferryboat *Queens,* which had been an obstruction in the College Point slip for some time, and Commissioner Whalen is said to be seriously considering the building of the Dyckman Street terminal with department labor and engineers. "We have met with such success in overcoming unexpected obstacles," Commissioner Whalen said, "that we can probably save about $75,000 by building the Dyckman Street terminal ourselves."

The contract for the construction of a pontoon, to cost about $5,000, is expected to be given out for bids during the course of the Dyckman Street work, and the $300,000 appropriation includes outside bids for such equipment as gears, etc.

In connection with the Grand Street Ferry Line, $695,000 has been voted, of which sum $444,000 is for the construction or the purchase of boats, $45,970 for the purpose of contracting for pontoons, gears and similar equipment; $125,030 for labor,

CHANGED MODEL

Satisfactory Results Favor Trial of West Lewark on Pacific Coast

Attended by Meyer Lissner, one of the recently appointed members of the United States Shipping Board, William Chisholm and F. C. Brandt, respectively manager and district comptroller of the Pacific District, Emergency Fleet Corporation of the United States Shipping Board; also by officials of the shipbuilding company, and a number of friends, the sea trials of the *West Lewark,* run the middle of June, proved eminently satisfactory.

This 11,500-ton flush deck freighter is the first to be completed of the five of her class being built and engined by the Los Angeles Shipbuilding & Dry Dock Company under contracts with the United States Shipping Board. Four hundred and fifty-five feet and nine inches over all, the *West Lewark* type is engined by the same 3,500 I.H.P. marine engine designed and built in the shops of this company for twenty-seven out of a total of thirty-five cargo carriers, which their contracts with the Shipping Board call for. The first thirty of these ships, twenty-two of which have the same type of engine as the above, were of 8,800 tons. Their over all length was 423 feet 5 inches. Considerable interest was, therefore, shown by all officials in the speed to be developed by the changed model with increased length in a ship designed to carry nearly 3,000 additional tons and with exceptionally efficient cargo storage and handling arrangements.

The *West Lewark* has been chartered by the Williams, Diamond & Company, Pacific Coast shippers. Capt. W. C. Ansell has been appointed master for the new ship by the operating company, and has arrived here to take charge of the ship and prepare for immediate sailing to San Francisco, Columbia River and Puget Sound points to load general cargo for the maiden voyage to London, Liverpool and Continental ports.

Notwithstanding the number of Shipping Board vessels reported as idle, the exceptional cargo storage and cargo handling facilities provided by the *West Lewark* made her particularly attractive to shippers for the Pacific-European trade.

Tanker Launched

The "Eurana," a single screw 63,000, 42-gallon barrel oil steamer, built at the plant of the New York Shipbuilding Corporation, Camden, N. J., was launched at 12:25 P. M., Saturday, July 16, 1921. It was christened by Miss Mary Eurana Ward, daughter of Dr. and Mrs. M. R. Ward, of Wayne, Pa., and niece of Mrs. Charles M. Schwab, of New York.

The over all dimensions of the ship are 435 ft. 8 in. in length, beam 56 ft. 3 in., and depth 25 ft. 10 in. She is equipped with 3 single end, Scotch, return tubular boilers. The main engine is of the vertical inverted triple expansion type, surface condensing, with three cranks at angles of 120 degrees. It is designed to develop sufficient power to propel the ship at least eleven (11) knots per hour with ship loaded to a mean draft of 25 ft. 6 in.

Steamship "American Legion" on Maiden Voyage After Trial Trip

Visiting Party on Board

On Saturday, July 16, the flag of the United States Shipping Board on the steamer *American Legion* was replaced by that of the Munson Steamship Line, with nearly every cabin occupied by guests of Mr. Munson. The steamer left the yards of its builders, the New York Shipbuilding Corporation, Camden, N. J., at 5:30 p. m., eastern standard time, and arrived at Pier 3, Hoboken, N. J., the following day at 4.30 p. m., daylight saving time.

The steamship *American Legion,* named in honor of our victorious soldiers, is one of the nine craft of 21,250 tons displacement being built at the plant of the New York Shipbuilding Corporation, Camden, N. J., for the United States Shipping Board. Since its launching, the *American Legion* has been allocated for operation to the Munson Line and will be run in the fast passenger service between New York and South American ports. Owing to the particular service to be performed by this vessel, it was necessary to make certain structural changes to meet the requirements for a maximum of air, light and space necessary for comfort in tropical travel. The vessel measures 535 feet over all and has a beam of 72 feet. It is equipped with twin turbines of 12,500 horsepower which will give it a speed of 17½ knots and has accommodations for 280 first class passengers, 194 third class passengers in addition to a crew of 198 officers and men.

In the party, besides Mr. and Mrs. Frank C. Munson were A. M. Neeland, president of the New York Shipbuilding Company and Mrs. Neeland; Shipping Board Commissioners Edward C. Plummer and Meyer Lissner; R. D. Gatewood, director of construction and repair; Harry C. Gahn, member of Congress from Ohio; Col. Thomas W. Miller, alien property custodian, and a number of members of the American Legion, including Col. Henry D. Lindsley, past national commander; William F. Deegan, vice-commander of the Department of New York; James M. Blackwell, chairman of the executive committee of the First District; George F. Kelly, adjutant, Department of New York; Col. E. A. Simmons, chairman of the American Legion Committee for the Reception and Disposition of Bodies from Overseas and also Commander of Kings County Post No. 500; Donald C. Strachan, chairman of the executive committee, Kings County; J. Noble Braden, vice-chairman, executive committee, Queens County; Col. Frank E. Evans, Lt. Col. Robert M. Watkins and Thomas W. Ward, Jr.

The *American Legion* sailed on its maiden voyage to South America on July 23. It is expected that her regular running time to the first port at which she will stop, Rio de Janeiro, will be approximately 10 days, which is some two days better than the record now held by the *Aeolus,* also of the Munson Line.

Sideways Launching a Success

The first sideways launching of a large ship in Baltimore occurred June 25, when the oil-burning tanker *San Leopoldo,* built by the Globe Shipbuilding & Dry Docks Company for the Eagle Oil Transportation Company, of London, went into the water at the Globe plant, Fairfield.

The *San Leopoldo* is the first of two tank steamers contracted for by the Eagle Oil Transport Company of London. The launching of this vessel for British interests is particularly significant in connection with the contract recently secured by the New York Shipbuilding Corporation for the construction of a large vessel for the Japanese government, as it shows that the American shipbuilder is a factor to be reckoned with in the world market for the construction of vessels.

ASKS $300,000,000

Chairman Lasker Makes Requests for Shipping Board

A comprehensive statement of the results of operation by the United States Shipping Board during the past year, which he said revealed a most deplorable system of accounting and gross incompetence and inefficiency in operation as a result, was made public by Chairman A. D. Lasker on July 18 as a preliminary to a conference with the chairmen of the Appropriations Committees of the House and the Senate on July 20 to ask for an appropriation of approximately $300,000,000 for the coming year. Of this he estimated that about $150,000,000 would be required to meet operating losses and $150,000,000 to pay claims. Before outlining the situation in a statement to the Washington newspaper correspondents Mr. Lasker had gone over the financial statement with the President, who, he said, was "shocked and dismayed" at the portrayal of conditions, and who had directed that the state of affairs be made public. The situation was presented as being so bad that the administration does not purpose to inherit it without acquainting Congress and the public with it in order that they may understand under what conditions the new board is beginning its work and in order that they may be fully informed of the results for the future.

According to the statement, the net expenditures of the Shipping Board for the year ended June 30, 1921, were $380,000,000, of which $220,000,000 represented a clear loss from operation, and it was announced that a reversal of policy had been decided upon so that cash realized from the sale of capital assets may no longer be expended for operating purposes, but shall be turned into the Treasury so that the direct loss from operation shall be known. This will make it possible to ascertain what it costs to operate a merchant marine and whether it will be necessary for the government to adopt some form of paternalistic aid.

While referring frequently in his statement to the deplorable bookkeeping and incompetency in the past management of the board and the "deception" of Congress and the people, Mr. Lasker said he was not intending to place the blame upon anyone, but to emphasize the conditions which face the new management. He said that even the $300,000,000 estimate of the requirements for this year was merely the most intelligent "wild guess" that could be made. The statement was made in the presence of Alonzo Tweedale, the general controller, and two of his assistants, and Mr. Lasker said that neither they nor Admiral Benson were responsible for a condition which they had inherited from the war emergency and had not had time to straighten out.

"The books are in deplorable condition," Mr. Lasker began; "in any commercial institution they wouldn't be called books at all. They were started in the stress of war and continued in the stress of incompetency until Mr. Tweedale and the others are now trying to straighten them out. Any of our great corporations would have been in receivers' hands long ago as a result of the way the books alone have been kept.

Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Oil Barge, Charleston, S. C.—It is reported that the Charleston Navy Yard has been authorized to construct an oil barge of 1,000 tons carrying capacity.

To Build Yacht, Morris Heights, N. Y.—The Consolidated Shipbuilding Corporation has received a contract to design and build a fast day cruiser for a prominent New York City yachtsman.

Standard Co. Awards, Shooters Island, N. Y.—On bids totaling approximately $2,500, the Standard Shipbuilding Corporation was awarded contracts for repairing the steamers Major Normoyle and Cantigny of the Army Transport Service.

Contract Award, Brooklyn, N. Y.—The James Shewan & Sons Company was awarded the contract for repairs to the steamer Buffalo Bridge, bids for which were opened at 45 Broadway, New York, on July 8. The price was $1,540.

To Repair Steamer, Seattle, Wash.—A contract for repairs and alterations to the steamship Keystone State was let to the Pacific Coast Engineering Works at a bid of $11,500.

Repairing Sound Steamer, Hoboken, N. J.—The W. & A. Fletcher Company has been awarded the contract for repairing the side-wheel Sound steamer C. W. Morse, of the Hudson Navigation Company. Repairing the broken starboard shaft is included in the work which it is understood will total close to $10,000.

Contract Award, Hoboken, N. J.—The Shipping Board steamer Sarcoxie, was awarded to the Tietjen & Lang Dry Dock Company for repairs, on a bid of $1,079.

Tanker Repair Contract, Baltimore, Md.—The Standard Oil Company on Wednesday, July 13, awarded the contract to dock and repair the tanker Muskogee to the Globe Shipbuilding & Dry Dock Company at its bid of $5,100.

Ferryboat, Ont., Canada.—It is reported that a company is being organized to build an automobile ferryboat to operate between Sarnia, Ont., and Port Huron, to handle the large motor tourist traffic across the St. Mary's River.

To Alter and Repair Wenatchee, Seattle, Wash.—Extensive alterations and repairs on the Shipping Board steamer Wenatchee will be recommended as a result of the trial run on Puget Sound recently in which the vessel showed many faults.

To Convert Steamers, Portland, Ore.—According to G. F. Matthews, shipbuilder, negotiations are under way for the financing by Eastern capital of the conversion of four more Ferris type Shipping Board wood hulls into sailing schooners at Portland, Oregon. Mr. Matthews has just completed the conversion of a Ferris type hull into the schooner Undaunted. Mr. F. C. Knapp, president of the Peninsula Lumber Company, is on the east coast conducting the negotiations.

Repair Contract, Shooters Island, N. Y.—The Standard Shipbuilding Corporation was awarded the contract for dry docking, painting and overhauling the Shipping Board steamer Cokato at a price of $4,041.

To Repair Destroyer, San Diego, Cal.—Six weeks' repairs will be necessary to place the United States destroyer Dent in cruising condition, according to an official announcement received by the commandant of the 11th naval district. The Dent was struck by a torpedo recently during smoke screen exercises off San Clemente Island.

Ship Repairs at Baltimore, Md.—The steamer Inland, in port from Portland, was docked at the lower plant of the Baltimore Dry Docks & Shipping Company for overhaul. The Baltimore Dry Docks & Shipbuilding Company was awarded the contract by the Shipping Board for repairing the steamer Elmsport at a bid of $1,113.

To Repair Lightships, Baltimore, Md.—A contract to dock and repair lightship No. 101, Cape Charles Station, has been awarded to the Baltimore Dry Docks & Shipbuilding Company. The Norfolk Shipbuilding & Dry Dock Company was awarded the contract for docking and painting light vessel No. 2.

Shipping Board Contracts, Brooklyn, N. Y.—The Robins Dry Dock & Repair Company with a bid of $4,181 has been awarded the contract for repairs to the Shipping Board steamer Old North State; the W. & A. Fletcher Company, Hoboken, has been awarded the repairs for the steamer Oronoke at a price of $3,530; the National Dry Docks & Repair Company has been awarded repairs on the steamer West Point at $2,544. Bids for these contracts were opened by the Shipping Board on July 6.

Will Launch Combination Vessel, Sparrows Point, Md.—Early in July the Sparrows Point plant of the Bethlehem Shipbuilding Corporation launched the largest vessel ever built at a Baltimore shipyard, and which was the first of four combination oil and ore carriers now on the stocks. This vessel is being built for the International Petroleum Company. All of the vessels are 550 feet long, 72 feet beam and 32 feet molded depth, to have a deadweight capacity of 20,500 tons. This vessel, as well as the other three, are being built on the Bethlehem Frear patent combination for carrying oil, ore, coal and merchandise. They will be driven by reciprocating engines with steam supplied by three Scotch boilers.

Hulls as Pile Rafts, Seattle, Wash.—Declaring that the hulls of many wooden ships now lying in Lake Union can earn millions if properly handled, Captain E. D. Barrett, of 2846 Alki Avenue, Seattle, is completing arrangements by which three hulls which he already owns will be used as molds or carriers to transport part of the immense piling order which New York will need to carry out her newest $15,000,000 harbor improvement plan. The hulls will necessarily have to be towed. It will cost approximately $16,000 to dock and fit the Ferris and Geary hulls for the trip and the outfitting and repowering of the steamer Roosevelt for the towing job involves more capital, which Captain Barrett is at present negotiating for. In towing these hulls to the East Coast with their cargo of piles, valued at $4,500,000, it is believed that Captain Barrett can deliver the full lot of 80,000 piles at a saving of $2,000,000. After unloading, the hulls are to be pumped out and towed back to the Sound in light ballast for another cargo.

Merchant Yard Activities.—The activity of the Merchant Shipbuilding Corporation in the general engineering field is evidenced by the consummation of two contracts running into large sums of money. One contract calls for the construction of two structural steel radio towers at Annapolis and for the remodeling of four existing towers. The towers contemplated are 600 feet in height.

The other contract provides for the construction of sixteen movable steel platforms for the construction firm of Snare & Triest, of New York. The latter firm is at present building some docks at Stapleton, S. I., and it is in connection with this work that the platforms are needed.

The Merchant Shipbuilding Corporation has filed bids for some 55 different kinds of construction work. These two are the successful bids that were announced thus far.

Light Vessels, Math, Maine.—Official announcement is made of the awarding of the contract for five light vessels by the Department of Commerce, Bureau of Lighthouses, Washington, D. C., to the Bath Iron Works, Ltd., in the amount of $920,000, this being the lowest bid received. The award is based upon the proposal of this company to build the first three vessels for $200,000 and additional vessels up to and including five ships for $160,000. The lightships are to be 132 feet 4 inches in length, 30 feet beam molded, of 775 tons, and will be equipped with one compound 16 inch by 31 inch engine, developing 400 indicated horsepower with a boiler working pressure of 120 pounds.

Steamer Repairs, Brooklyn, N. Y.—Tenders were opened at 3 P. M., on July 13 at the office of Scott & Surtees, Consulting Engineers, 80 Broad Street, New York, for repairs to the steamship Fort Morgan, of the Di Georgio Line, which was recently damaged in collision with an unknown schooner at sea. The contract was awarded to the Morse Dry Dock & Repair Company on a bid of $8,650 and ten days.

Recondition Tanker, Brooklyn, N. Y.—The contract for overhauling and cleaning the tank ship Delmira, bids for which were opened on Monday, July 11, was awarded to the Robins Dry Dock & Repair Company on a total bid of $10,505. The Delmira recently arrived at New York in tow from the south. The large quantity of oil floating in her hull is to be removed, the specifications being in two sections.

Repair Tankers, Newport News, Va.—The Newport News Shipbuilding Company was awarded contracts for docking and repairing the Danzig oil tankers Zoppot and Baltic which have been operated by the Standard Oil Company in the Mexican oil trade. The company was the lowest bidder at a price of $6,250 for the Baltic and $7,412 on the Zoppot. Other bids for the Baltic were: Baltimore Dry Docks & Shipbuilding Company, $6,996; Globe Shipbuilding Company, $9,116; Bethlehem Shipbuilding Corporation, $13,908; and for the Zoppot, Baltimore Dry Docks & Shipbuilding, $7,975; Globe, $10,636; Bethlehem, $16,920.

Repair Contracts, Baltimore, Md.—Contract to dock and repair to steamer Cushnoc was awarded by the Shipping Board to the Globe Shipbuilding & Dry Dock Company, Baltimore, Md., on a bid of $5,280. The steamer West Lasraway was awarded to the Bethlehem Shipbuilding Corporation, Sparrows Point, Md., on a bid of $4,160. Five other dock and repair contracts were also awarded this week by the Shipping Board, as follows: Steamer Sutherland to the Baltimore Dry Docks & Shipbuilding Company, at $8,277; steamer Capulin, to the Bethlehem Shipbuilding Corporation, $2,470; the Belvedere, to the Baltimore Dry Docks at $1,244; repairs to the Des Moines Bridge to the Spedden Shipbuilding Company, at $167 and the National Bridge to the same company at $531.

Activities at Fletcher Yard, Hoboken, N. J.—The Fletcher Company has been awarded the repair work incidental to scheduled voyages on five ships of the United Fruit Company's fleet. The vessels are the Santa Marta, Zapaca, Tivivies, Sixaola and Carrillo, of about 5,000 gross tons each. These ships ply between New York and South American ports.

The Fletcher Company has also been awarded the contract for repairs and a special No. 3 American Bureau survey on the steamship Transportation of the Coastwise Transportation Company at an estimated cost of $10,000. Other awards to the same company include the Shipping Board steamer Panhandle State for the opening of all main and auxiliary machinery for inspection and survey in addition to local voyage repairs, at a figure of $2,300; the Shipping Board steamer Gaffney for dry docking and voyage repairs, about $2,000; and the revenue cutter Seneca for dry docking, general overhauling and reconditioning. It was stated that although the Fletcher Company's dry dock will be moved from the north side of pier 3 to the south side of the same pier, the dry dock will continue in operation without interruption, the removal being for the purpose of providing sufficient depth in the slip so that the dock will lift ships of greater draft than any other dock of its size in the port.

Repair Ship.—Bids were opened on June 28 for repairs to the United American Line steamer Suffolk, and the Morse Dry Dock & Repair Company was announced as having been awarded the contract at a price of $20,500. Other bidders were: Standard Shipbuilding Corporation, $18,500; James Shewan & Son, $21,000; Newport News Shipbuilding & D. D. Co., $21,400; Atlantic Basin Iron Works, $23,000; New York Harbor Dry Dock Co., $23,667; National Shipbuilding Company, $24,184; W. & A. Fletcher Company, $26,800; Crane's Shipyard, $34,000; Merchant Shipbuilding Corporation, $53,080.

CONSTRUCTION FOR NAVY

Vessels under construction for the United States Navy and their degree of completion as reported June 30, 1921, by the Bureau of Construction and Repair, Washington, D. C., are as follows:

Type Number and Name	Contractor	Per Cent. of Completion July 1 Total
BATTLESHIPS (BB)		
44 California	Mare Island Navy Yard	98.0
45 Colorado	New York S. B. Corpn.	75.4
46 Maryland	Newport News S. B. & D. D. Co.	99.5
47 Washington	New York S. B. Corpn.	67.3
48 West Virginia	Newport News S. B. & D. D. Co.	57.
49 South Dakota	New York Navy Yard	32.2
50 Indiana	New York Navy Yard	29.8
51 Montana	Mare Island Navy Yard	26.1
52 North Carolina	Norfolk Navy Yard	35.8
53 Iowa	Newport News S. B. & D. D. Co.	26.3
54 Massachusetts	Beth. S. B. Corpn. (Fore River)	8.6
BATTLE CRUISERS (CC)		
1 Lexington	Beth. S. B. Corpn. (Fore River)	21.1
2 Constellation	Newport News S. B. & D. D. Co.	11.5
3 Saratoga	New York S. B. Corpn.	24.2
*4 Ranger	Newport News S. B. & D. D. Co.	2.0
5 Constitution	Philadelphia Navy Yard	9.2
6 United States	Philadelphia Navy Yard	9.2
SCOUT CRUISERS (LIGHT CRUISERS CL)		
4 Omaha	Todd D. D. & Const. Corpn.	93.0
5 Milwaukee	Todd D. D. & Const. Corpn.	90.5
6 Cincinnati	Todd D. D. & Const. Corpn.	84.4
7 Raleigh	Beth. S. B. Corpn. (Fore River)	59.7
8 Detroit	Beth. S. B. Corpn. (Fore River)	59.8
9 Richmond	Wm. Cramp & Sons Co.	67.
10 Concord	Wm. Cramp & Sons Co.	64.
11 Trenton	Wm. Cramp & Sons Co.	47.
12 Marblehead	Wm. Cramp & Sons Co.	45.
13 Memphis	Wm. Cramp & Sons Co.	39.
*Battle cruiser No. 4—Keel laid 6-23-21.		
AUXILIARIES		
Fuel Ship No. 18, Pecos (Oiler AO6)	Boston Navy Yard	97.2
Repair Ship No. 1, Medusa (AR1)	Puget Sound Navy Yard	63.6
Dest. Tender No. 3, Dobbin (AD3)	Philadelphia Navy Yard	64.8
Dest. Tender No. 4, Whitney (AD4)	Boston Navy Yard	28.9
Sub. Tender No. 3, Holland (AS3)	Puget Sound Navy Yard	20.2
Aircraft Tender, Wright (AZ1)	Tietjen & Lang	80.
PATROL VESSELS		
Gunboat No. 22, Tulsa (PG22)	Charleston Navy Yard	69.2
Authorized but not under construction or contract. (1) Transport No. 2.		
DESTROYERS		
338 Wasmuth	Mare Island Navy Yard	98.1
339 Trever	Mare Island Navy Yard	95.0
340 Perry	Mare Island Navy Yard	63.3
341 Decatur	Mare Island Navy Yard	59.5
Destroyers authorized but not under construction or contract. (12) Nos. 348 to 359 inclusive.		
SUBMARINES		
115 S-10	Portsmouth, N. H., Navy Yard	92.
116 S-11	Portsmouth, N. H., Navy Yard	88.4
117 S-12	Portsmouth, N. H., Navy Yard	82.8
118 S-13	Portsmouth, N. H., Navy Yard	77.
123 S-18	Electric Boat Co. (Quincy)	97.
124 S-19	Electric Boat Co. (Quincy)	96.5
125 S-20	Electric Boat Co. (Quincy)	98.5
126 S-21	Electric Boat Co. (Quincy)	94.9
127 S-22	Electric Boat Co. (Quincy)	95.8
128 S-23	Electric Boat Co. (Quincy)	94.0
129 S-24	Electric Boat Co. (Quincy)	93.
130 S-25	Electric Boat Co. (Quincy)	93.5
131 S-26	Electric Boat Co. (Quincy)	92.4
132 S-27	Electric Boat Co. (Quincy)	91.
133 S-28	Electric Boat Co. (Quincy)	91.6
134 S-29	Electric Boat Co. (Quincy)	90.5
136 S-31	Electric Boat Co. (San Fran.)	97.5
137 S-32	Electric Boat Co. (San Fran.)	95.9
138 S-33	Electric Boat Co. (San Fran.)	99.2
139 S-34	Electric Boat Co. (San Fran.)	95.
140 S-35	Electric Boat Co. (San Fran.)	91.2
141 S-36	Electric Boat Co. (San Fran.)	87.2
142 S-37	Electric Boat Co. (San Fran.)	84.5
143 S-38	Electric Boat Co. (San Fran.)	75.2
144 S-39	Electric Boat Co. (San Fran.)	72.3
145 S-40	Electric Boat Co. (San Fran.)	72.6
146 S-41	Electric Boat Co. (San Fran.)	75.5
153 S-42	Electric Boat Co. (Quincy)	67.7
154 S-43	Electric Boat Co. (Quincy)	67.9
155 S-44	Electric Boat Co. (Quincy)	66.3
156 S-45	Electric Boat Co. (Quincy)	67.
157 S-46	Electric Boat Co. (Quincy)	65.4
158 S-47	Electric Boat Co. (Quincy)	64.9
159 S-48	Lake T. B. Co. (Bridgeport)	93.3
160 S-49	Lake T. B. Co. (Bridgeport)	86.2
161 S-50	Lake T. B. Co. (Bridgeport)	85.3
162 S-51	Lake T. B. Co. (Bridgeport)	78.2
FLEET SUBMARINES		
60 T-2 (SF 2)	Electric Boat Co. (Quincy)	98.7
163 V-1 (SF 4)	Portsmouth, N. H., Navy Yard	2.8
164 V-2 (SF 5)	Portsmouth, N. H., Navy Yard	2.8
165 V-3 (SF 6)	Portsmouth, N. H., Navy Yard	2.8
Note: Submarines authorized but not under construction or contract. Fleet submarines (6) Nos. 166 to 171. Neff submarine (1) No. 108.		

Ferryboat, Seattle, Wash.—It is announced that bids will soon be asked for a passenger ferry to ply between Seattle and Puget Sound Navy Yard, for which plans have already been approved. The vessel will have a large passenger and auto carrying capacity and will cost about $500,000.

Overhauling Vessels, Seattle, Wash.—For annual overhauling and repairs the steamships Norwood and Redwood of the Pacific American Fisheries Company's fleet are now drydocked at the Todd Shipyards, and surveys to determine the extent of the work being made. A new stern frame is being installed on the Shipping Board freighter West Jester, and it is expected the vessel will be ready for her sailing on August 1. The surveying of the big transpacific passenger liners Wenatchee and Keystone State continues at the Todd yard. As soon as this is done bids for repairing the vessels will be asked and let at once.

Repairing Steamer, Baltimore, Md.—The Baltimore Dry Docks & Shipbuilding Company was the lowest bidder for the contract to dock and repair the steamer Eastern Importer of the United States Shipping Board, at a bid of $2,757. The Bethlehem Shipbuilding Corporation bid $2,850, and the Globe Shipbuilding & Dry Dock Company, $2,999.

Tanker Repairs, Hunters Point, Cal.—The hull of the new tanker Scopas was damaged when the vessel was recently launched from the ways of the Southwestern Shipbuilding Company, and will be repaired at the No. 2 graving dock of the Bethlehem Shipbuilding Corporation. The vessel has a tonnage of 8,400.

Repair Contract Awards, Baltimore, Md.—To dock and repair the steamer Lake Elon, the Shipping Board awarded the work to the Baltimore Dry Docks & Shipbuilding Company on its bid of $1,687. The Globe Shipbuilding Company bid $2,257, and the Bethlehem Shipbuilding Corporation $1,868. The steamer Labette was awarded by the Shipping Board to Obrecht & Company at $370; and the Lake Felden to the Union Shipbuilding Company at $458.

Battleship to be Launched, Camden, N. J.—According to an announcement from the Navy Department the Washington, the third American battleship having electric propulsion, will be launched at Camden, N. J., early in September. The new Washington is a sister ship of the Maryland, which it is expected will be turned over to the Navy early in August, and the Colorado and West Virginia, now in the course of construction, all mounting 16-inch guns.

New Cable Ship, New York.—Plans and specifications have been sent to various shipbuilders by J. W. Millard, naval architect, of 17 State Street, New York City, for the construction of a Western Union cable ship which is to be equipped with four Diesel engines, driving electric generators and motor with a brake horsepower for the main engine estimated at 2,000. The vessel is to have twin screws. She will be 324 feet between perpendiculars, 356 feet over all length, 42 feet 6 inches molded breadth, 25 feet molded depth.

Alterations on Liners.—It was reported in marine circles that specifications will be forthcoming for alterations to the steamship Panhandle State to provide for accommodations for 600 steerage passengers and incidental repair work which it was thought would reach the approximate total of $100,000. It is also understood that plans are being prepared for the carrying out of betterments for the steamship America in the amount of about $60,000.

Ferryboats, New York.—Maurice Nicholls, of 90 West Street, New York City, is in the market for two double-ended side wheel or screw ferryboats having a speed of about nine or ten knots. A passenger carrying capacity of 1,500 is desired.

SHIPYARDS AND DRY DOCKS

New Dry Dock, Kearney, N. J.—The Federal Shipbuilding Company announces the completion of its new dry dock. The dock measures 438 feet from tip to tip in length with an over-all width of 110 feet. It is of the Donnelly type made up of nine pontoons and will take a vessel of 9,000 long tons and up to 460 feet in length.

May Purchase Plant, Harriman, Pa.—It is reported that the Merchant Shipbuilding Corporation is negotiating with the United States Shipping Board, Washington, D. C., for the acquisition of the plant, of which the company owns the land and the Government the buildings. A new structural department was established recently and the company has started work in this new department.

To Build Diesel Engines, San Francisco, Cal.—The Bethlehem Shipbuilding Corporation is putting in facilities at its local plant as well as at the company's works in Alameda for the manufacture of American-Diesel marine engines on a large scale. J. J. Tynan is general manager.

New Dry Dock to be Installed, East San Pedro, Cal.—According to an announcement made by J. A. Talbott, vice-president and general manager of the Southwestern Shipbuilding Company, a new 12,000 ton floating dry dock will soon be installed at the plant of the company. This organization's huge plant at East San Pedro will not be dismantled upon the completion of its present contract on October 1, but will continue in the shipbuilding and ship repair field.

PORT IMPROVEMENTS

Wharf, Etc., New Orleans, La.—The Dock Board will expend $275,000 on a wharf for Alabo and $57,000 on the Government barge terminal.

Dock, Houston, Texas.—W. C. Hogg and associates contemplate the construction of a dock and handling plant for coal and other heavy commodities.

Building Dock, Kalama, Washington.—Captain Jack Reid of the Reid Transportation Company has a new landing dock under construction at Kalama between the depot and the Hoven ferry dock for the use of his ferryboats.

Harbor to Be Improved, Port Lavaca, Tex.—The city plans to improve its harbor with an expenditure of about $125,000. Address the mayor.

To Improve Channel, Lincoln, Ill.—The Commissioners, Upper Salt Creek, D. D., plan to improve the channel, involving 1,000,000 cubic yards. Kelker, Gates and DeLeuw, Conway Building, Chicago, are the engineers.

Wharf, Etc., Orange, Tex.—The city, W. E. Lea, mayor, voted $250,000 bonds to construct additional wharf and dock facilities.

Dock, Mobile, Ala.—Harry Pillans, mayor, will complete the construction of the Arlington docks and contemplates the voting of bonds for this purpose in the amount of $500,000.

Dredging, Cleveland, Ohio.—The city plans to dredge three miles of the Cuyahoga River, involving the expenditure of about $1,000,000. R. Hoffman, City Hall, is engineer.

Dock, Houston, Tex.—The Humble Oil and Refining Company plans to build a 20 by 100 foot concrete pile and slab construction dock near Morgan's Point for bunkering and loading oil barges.

Bulkhead, Baltimore, Md.—The Public Improvement Commission in compliance with a request from the United States Engineers, will construct a temporary bulkhead to cost $4,000, across the river frontage of Mud Island space. Bancroft Hill is harbor engineer.

Pier, Bayonne, N. J.—The Union Sulphur Company, 17 Battery Place, New York, has awarded a contract for the construction of a pier to cost about $20,000, to Henry Steers, Inc., 17 Battery Place, New York.

Wharf, New Orleans, La.—The Dock Board is planning the construction of a $400,000 wharf behind which a warehouse will be built by the Mississippi Warrior Barge Line at New Orleans for the purpose of developing that port as a clearance port for flour and cotton. The proposed wharf will be approximately 600 feet long and 75 feet wide.

Seawall, Scituate, Mass.—J. H. Williams, 76 Faysant Street, Boston, Mass., has been awarded a contract by the Department of Public Works for building 2,300 feet of concrete seawall, 13 feet high, and involving 4,300 cubic yards of concrete.

Pier, Bradentown, Fla.—W. Curry, administrator of the Curry Estate will construct a pier at the foot of Sunset Drive, on the Mantee River.

To Dredge Channel, Portland, Ore.—The Port of Portland Commission has received from the United States Army Engineers, Washington, a permit for the proposed improvement of the North Portland harbor by the dredging of a channel 25 feet deep and 300 feet wide, and by the construction of wing-dams, according to plans.

Dredging, Etc., Mass.—The estate of J. R. Burke, 28 School Street, Boston, Mass., has been awarded a contract for dredging, placing rip-rap, and removing boulders in Harwichport, Harwich, Hyannisport, Falmouth, Inner Harbor, Osterville, North Falmouth, and Martha's Vineyard. The work will involve the expenditure of $67,612.

Bulkhead, New York.—Murray Hulbert, Commissioner of Docks, Pier A, North River, New York, has let a contract for reconstructing the sheet pile bulkhead along Shore Boulevard, Sheepshead Bay, contract No. 1715, to G. W. Rogers & Company, Inc., 29 Broadway, New York City. The job involves the expenditure of $47,370.

Piers, Miami, Fla.—The city will construct additional piers at the municipal docks, and will receive bids until July 20 for part of the $400,000 project development which will double the capacity of the present docks. Charles W. Murray is engineer in charge.

Freight Handling Equipment, Orange, Texas.—Freight handling and conveying machinery will be installed on the new wharf and dock which the City Council plans to construct in the near future. Bonds in the amount of $250,000 have been voted for this project.

Bulkhead, Boston, Mass.—W. L. Miller, 171 Alford Street, Charleston, Mass., was awarded the contract for the construction of a 2,400-foot oak pile and hard pine timber bulkhead on Commonwealth Flats, at a price of $56,000.

Deepen Channel, Tallahassee, Fla.—The city has asked for an appropriation of at least $100,000 for the purpose of deepening the channel of the Blackwater Bay and the Blackwater River up as far as the town of Milton in Santa Rosa county. The bill has been taken up for consideration.

Dumping Board, New York.—Murray Hulbert, Commissioner of Docks, Pier A, North River, New York, has let a contract to the Phoenix Construction Company, 41 Park Row, for building the substructure for the proposed dumping board on East 35th Street. This work will cost about $69,797.

Docks, Port Arthur, Ont.—The Palentine Mining & Development Company proposes to buy 200 acres on the Stratcona property near Bare Point for $10,000, including the water rights for the construction of four ore docks with a capacity of approximately 500,000 tons, rack dock to be 100 feet wide and about 1,000 feet long. They are to be of concrete and steel on an elevation, including trestles, of 80 feet. The foundations will be of concrete and the hoppers and main sections of steel of the same type as the ore docks at Duluth and Two Harbors, Minn. A by-law is to be submitted to Port Arthur taxpayers shortly concerning this proposed construction.

Dredging, Cloverdale, B. C.—The municipality of Surrey has let a contract for dredging and dyking on the upper part of the Serpentine River to H. B. Sullivan & Company, 47 Albert Crescent, New Westminster, to cost $34,000.

Hydraulic Dredge, St. Louis, Mo.—The Mississippi River Commissioner, International Life Building, is receiving bids for furnishing a 12-inch hydraulic dredge for the Mississippi to cost about $112,000.

Sub-structure of Pier, Philadelphia, Pa.—George F. Sproule, director of the Department of Wharves, Docks and Ferries, 550 Bourse Building, will receive bids endorsed "Bids for the construction with appurtenant work, of the sub-structure of Girard Pier, No. 3, North Delaware River," until 12 o'clock noon (daylight saving time), Monday, August 1, 1921. Plans and specifications and blank forms upon which bids must be made can be obtained at the office of Director Sproule upon the deposit of a certified check in the sum of $25.

Wharf, Houston, Tex.—Mayor Holcombe has authorized the construction of Manchester wharf and has directed City Engineer to prepare plans and specifications.

Bulkhead, Etc., Tampa, Fla.—The city will expend about $1,000,000 for harbor improvements to include a bulkhead, etc. A. W. D. Hall is city manager.

GOVERNMENT WORK

Machine Shop, Fort Crockett, Tex.—The Bureau of Yards and Docks, Navy Department, has awarded a contract to J. N. McCannon, Fort Bliss, Texas, for the construction of a one-story addition to the machine shop.

Dump Scow, New York.—The Phoenix Construction Company, 41 Park Row, New York, was the lowest bidder for the construction of a dump scow at the Navy Yard, New York, (1) work complete, $20,897, sixty days; (2) add $40, deduct $20; (3) add $0.05, deduct $0.25; (4) add $1,553 (5) deduct $50.

Quay Wall Extension, San Diego, Cal.—Specification 4484, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a quay wall extension involving the expenditure of about $106,000.

Dredging, Etc., San Diego, Cal.—Specification 4485, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to dredge, fill and repair the base.

Dock and Piers, St. Louis, Mo.—The War Department, Washington, D. C., has leased a site on a profit-sharing basis to erect a $40,000 dock of wood construction and two concrete piers, each to cost $90,000, which will connect with Wiggins Ferry.

Dispensary, Washington, D. C.—Specification 4486, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a dispensary estimated to cost about $75,000.

Steam Cranes, Puget Sound, Wash.—Specification 4478, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct two 50-ton steam cranes for the dry dock at Puget Sound, at an estimated cost of $320,000.

Road to Dry Dock, South Boston, Mass.—Specification 4477, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a road to the drydock.

Machine Shop, San Diego, Cal.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., let the contract for constructing a machine shop, fire engine house, etc., at the Naval air station to the K. E. Parker Company, 519 California Street, at a figure of $121,400 and 210 days.

Radio Towers, Sitka, Alaska.—Specification 4445, the Bureau of Yards and Docks, Navy Department, Washington, D. C., let a contract for constructing two 300-foot steel radio towers and one 200-foot Guyed Tubular Mast at the Naval Radio Station to the Hurley-Mason Company, 4 North Main Street, Seattle, Washington, at a cost of $22,220 and 175 days.

Contract Let for Machine Shop, Hampton Roads, Va.—W. F. Martins, 53 Franklin St., Rochester, N. Y., was awarded the contract, Specification 4382, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for constructing the machine and carpenter shop at a price of $108,434 and 165 days.

Electric Power Plant, Craney Island, Va.—The United States Shipping Board, Washington, D. C., plans to construct a new electric power plant near Norfolk, Va., and to install an electrically operated pumping plant.

Repairs to Dredge, Charleston, S. C.—The United States Engineer Office, Munitions Building, Washington, D. C., has let a contract for repairing the dredge Barnard to the Charleston Dry Dock & Machine Company at a price of $22,599.

Machine Shop Foundation, Pearl Harbor, T. H.—Specification 4396, The Bureau of Yards and Docks, Navy Department, Washington, D. C., has rejected bids received on June 29 for constructing a foundation for a machine shop.

To Sell Vessels, Washington, D. C.—The Shipping Board will receive proposals up to August 2 at its office in Washington for three ex-German ships "as is and where is," now at New York. These are the Amphion, deadweight tonnage 8,950; the Freedom, 6,800 tons, and the Philippines, 13,312 tons.

Dredging, Buffalo, N. Y.—The United States Engineer Office will receive bids until 11 a. m., August 18, 1921, for dredging and rock excavating in the Black Rock Channel. Further information may be obtained upon application.

Dredging, Philadelphia, Pa.—The United States Engineer Office, 815 Witherspoon Building, will receive bids until August 22, 1921, for dredging a 35-foot channel in the lower part of the Delaware River. Further information may be obtained upon application.

Jib Cranes, Brooklyn, N. Y.—C. L. Cadle, superintendent of Public Works, Capitol, Albany, N. Y., will receive bids until August 17, 1921, for furnishing and installing two 3-ton electric semi-portal revolving jib cranes on the barge canal terminal, Gowanus Bay; Contract No. 118.

Piers and Abutments, Dayton, Ohio.—The Commissioners of Montgomery County will receive bids until August 20 for building piers and abutments for a three-span steel highway bridge across the Miami River on Sheperd Road, involving 5,000 cubic yards mass. concrete, and costing about $60,000. P. S. Bookwalter is county engineer.

Chimney, Bellevue, D. C.—Specification 4483, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a chimney at Bellevue, D. C.

Portable Water Supply, Lakehurst, N. J.—Specification 4424, the Bureau of Yards and Docks, Navy Department, Washington, D. C., let a contract for constructing a portable water supply at the Naval Air Station to the H. E. Crock Company, 28 Light Street, Baltimore, Md., the work to be completed in ninety days at a cost of $12,339.

Radio Towers, Annapolis, Md.—Specification 4400, the Bureau of Yards and Docks, Navy Department, Washington, D. C., let a contract for building steel towers at the Naval High Power Station to the McClintic Marshall Construction Company, Munsey building, Washington, D. C. This job amounts to $112,255.

NEW INCORPORATIONS

The Algiers Dry Dock & Ship Repair Company is to be organized in Algiers, La., shortly, according to a report coming from the leading factor in the new enterprise, Edward Berhaut, proprietor of the Algiers Iron Works and the Algiers Electric Welding Company. Mr. Berhaut is said to have asserted that the new concern will represent an investment of $1,000,000 and will be financed by local capital.

The firm of Rinelli & Guardino, Inc., Wilmington, Del., has been incorporated with a capital of $500,000 to conduct a business of scaling and cleaning ships, etc.

The Munrio Steamship Corporation, Wilmington, Del., has been incorporated with a capital of $275,000 to carry on a shipping business.

The Floating Marine Stores, Inc., Brooklyn, N. Y., has been incorporated with a capital of $10,000 by R. Simon, 2231 Emmons Avenue, Sheepshead Bay, to conduct a marine and ship supply business.

The Astoria Shipping Company, Astoria, Oregon, has been incorporated with a capital of $10,000 by C. K. West, B. F. Stone, and O. B. Setters, to conduct a general shipping business.

The Automatic Clutch & Transmission Company, Wilmington, Del., has been incorporated with a capital of $1,200,000 to manufacture clutches, power controlling mechanism, etc.

The Graham Sloan Company, Inc., 15 Exchange Place, Jersey City, N. J., has been incorporated with a capital of $250,000 to carry on a business of building, construction, dredging and demolishing.

The Frontera Fruit & Steamship Company, Wilmington, Del., has been incorporated with a capital of $150,000 to own and operate boats.

The Benson Electric Company, Superior, Wis., has been incorporated with a capital of $1,000.000 by M. B. Johnson, Arthur W. Highfield and Horatio V. Gard, Superior, Wis., to do a contracting business; attorney, Corporation Trust Company of America.

The International Marine Life Savings Equipment Corporation has been incorporated with a capital of $520,000 to carry on a business of marine specialties; Kyriajos Souliotis, John E. Ellys, Far Rockaway, N. Y., and Michael Johnell, New York, are the incorporators; attorney, U. S. Corporation Company.

The Iroquois Navigation Company has been incorporated with a capital of $500,000 by Harry C. Hand, Samuel B. Howard, and Robert K. Thistle, all of New York; attorney, U. S. Corporation Company.

FOREIGN ACTIVITIES

Graving Dock, Sunderland, Eng.—A new graving dock is to be constructed in the port of Sunderland by Messrs. T. W. Greenwell & Company, Ltd. The dock will be 550 feet long and 71 feet wide at the entrance, and will be able to accommodate the largest vessels built on the Wear.

Clyde Output for May.—In May Clyde shipbuilding companies launched nineteen vessels aggregating 22,752 gross tons, bringing the totals for the five months of the year to date up to 102 vessels and 195,429 tons gross. During the month two vessels of 186 tons were launched from Forth yards and a vessel of 500 tons from a Scottish Northeast Coast yard.

Converted Cargo Vessel, Newcastle-on-Tyne, Eng.—The Newcastle Engineering Company, Ltd., Tyne Dock, recently completed an interesting conversion job. The coasting vessel Cargo Shipper, owned by Cargo Carriers, Ltd., of London, which was an auxiliary schooner, 136 feet in length, was turned into a motor ship by the installation of a 152 brake horsepower Vickers-Petter oil engine, directly reversible, of the latest type. The auxiliary machinery is driven by a small Petter oil engine and is entirely self-contained.

Dredging, Alexandria.—The Great Pass at Alexandria is to be dredged to a depth of 45 feet in connection with the proposed scheme for the construction of new docks and berths alongside which the depth of water is to be 40 feet, and which will be able to accommodate vessels 1.000 feet long. The estimated cost of the scheme for the construction of new berths is £E.1,400,000, and it is one which is greatly welcomed by the shipping industry.

Naval Programme, France.—The new naval programme, passed by the French Chamber on the 10th

of June, provides for the construction of six light cruisers, twelve destroyers, twelve torpedo boats and thirty-six submarines, and the conversion of the battleship Bearn into an aircraft carrier.

Wharf, Acapulco, Mexico.—The Mexican Government has approved the expenditure of 75,000 pesos (equal to about $37,500 United States currency) monthly for the construction of a wharf, work upon which is to be started shortly. Plans and specifications may be obtained from the Ministro de Communicaciones y Obras Publicas, Mexico.

New Shipyard, Belgium.—A shipyard is being laid down on the Ghent-Terneuzen Canal by the Societe Anonyme Anglo-Belge de Constructions Navales. A number of berths will be constructed for the building of vessels from 350 feet to 660 feet in length. The depth of water at the yard is 28 feet.

German Shipyard Expansion. — The Deutsche Werft, A. G., which was founded in 1918 and whose yard is at Finkenwarder, is still engaged in laying out its works. It is reported that during the past year it has amalgamated with the Hamburger Werft laid out at Tollerost in 1916 and has thereby become the largest shipbuilding establishment in the country. Ship construction work began last year in May when the keels for three 2,000 ton vessels and three 4,000 ton vessels were laid. In June the nine 750-foot building berths were sufficiently advanced for an 8,000 ton turbine steamer to be laid down. The contracts in hand on December 31, 1920, numbered 28 steamers of 133,350 tons deadweight, 10 motorships of 61,200 tons, eight barges of 8,000 tons, and two floating docks of 6,500 tons, in all 209,250 tons, providing employment to June, 1922. At the present time there is renewed inquiry for motorships, tankers, and floating docks. The gross profits for 1920 totalled 9,932,910 marks, and the net profits 692,373 marks.

Activities at Krupp's, Germany.—The Germania shipbuilding plant of Krupp's at Kiel-gaardon is building passenger and freight steamers. At its various other establishments the company is manufacturing a great variety of work, including locomotives and railway supplies of all kinds, machines for the textile and paper industry, dredgers, floating docks, pneumatic tools, Diesel engines, etc. tions are doing this work and today the company is The same workmen who during the war made muniactually employing more men than before the war.

Cargo Steamers, Nantes, France.—The latest keel down at Nantes, where considerable activity in shipbuilding is very evident, is that of the cargo steamer Mellinet of 4,500 tons deadweight. The Chantiers de Bretague have just completed the cargo boat Cevennes, the last of seven sister ships ordered by M. M. Delmas Freres, of La Rochelle.

Harbor to be Dredged, Malmo, Sweden.—The free harbor at Malmo is to be dredged to a depth of 30 feet. The necessary financial support has already been agreed to, and it is hoped that the work will be completed by the first of July of next year. The work will be expedited as much as possible in order to have it ready for opening at the same time as the free harbor at Gothenburg.

Swedish Tonnage Output.—The "Swedish Export" states that the total tonnage of vessels launched in Sweden for the year 1920 was 42,000 tons gross. This figure is practically the same as for the previous year. Before the war the record figure reached was 22,000 tons in the year 1913.

New Shipyard, Italy.—A new shipyard has been constructed by the Italian Limited Company Ernesto Bread with a share capital L100,000,000 fully paid. The principal works and plants of the yard are now practically complete and production will soon begin. The site occupies an area of 130 acres and it is near the new harbor and industrial zone of Venice. The yard is equipped with the latest appliances with modern and powerful machines and vessels up to 950 in length can be laid down in the building berths.

Shipbuilding and Repair Plant Wanted, Bahama Islands.—According to a statement accredited to the Bahamas Development Board, there is an opening for the establishment of a shipbuilding and ship repairing plant at Nassau. The present ways are capable of accommodating small vessels only, but with the development of the port a dry dock or slipway to accommodate vessels of 1,000 tons or over will be necessary.

Floating Dock, New South Wales.—It is reported that the Commonwealth Government of Australia may build a floating dock of 55,000 tons capacity to improve its ship repairing facilities.

British Shipbuilding Figures.—The report of Lloyd's Register of Shipbuilding for the quarter ended June 30 shows a gross tonnage of 3,578,153 of new shipbuilding in the United Kingdom to date. From this a total of 1,179,000 tons, representing contracts suspended and postponed has to be deducted, leaving the net total building of 2,351,047 tons. Adding tonnage under construction in the Empire, the British total is 2,528,959 tons, or more by 37,450 tons than all the rest of the world together. The total includes 89 oil tankers of 585,980 gross tons. The total tonnage building in the United Kingdom is 268,000 tons less than at the end of the March quarter and 48,000 tons less than a year ago. The total tonnage launched during the second quarter of this year amounts to 321,690 tons, while the launching for the first quarter was 425,700 tons. The launchings represent only 2 per cent. of tonnage in hand.

Baltic Reconditioned.—Looking as fit as on the day she left Belfast on her first trials in 1904, the White Star liner Baltic has sailed from Messrs. Harland & Wolff's, after undergoing six months' reconditioning by the famous Queen's Island firm. During her stay in Belfast the Baltic has been entirely overhauled. The first-class accommodation has been improved by the provision of additional private bathrooms, while there have been numerous alterations in the accommodation with the object of bringing everything into line with the most modern requirements, and the public rooms have been redecorated. The machinery has also been thoroughly overhauled, and the ship is as good as new. The only White Star tonnage now in hand in Belfast is the Doric, which is on the berth in the North yard, but owing to prevailing conditions is not likely to be launched for some time.

Nereus Launched.—There was launched from the yard of the N. V. Ijselwerf, at Kampen, on June 22, the steamship Nereus, under construction for the Koninklijke Nederlandsche Stoomboot Maatschappij, of Amsterdam. The dimensions of the Nereus are: Length between perpendiculars, 226 ft.; breadth, 34 ft.; depth to the main deck, 15 ft. Triple expansion engines, developing about 600 i.h.p., and all the auxiliary machinery and winches are being supplied by the Machinefabriek Utrecht, of Utrecht.

Steamer Building.—The China Reederei A. G., in its report for 1920, states that it has a steamer of 3,200 tons gross, building at the Howaldtswerken at Kiel, for delivery early in 1922.

LAUNCHINGS.

Tilthorn.—The steamer Tilthorn, built to the order of Messrs. Dampskibaktieselkapet, "Britannia," Bergen, was recently launched from the yard of William Doxford & Sons, Ltd., Sunderland, England. She is 420 feet in length, 54 feet breadth and 37 feet in depth, of the closed shelter deck type, and 10,800 tons capacity on 28¼ feet draft, with a speed of 12 knots. She was built under the supervision of Messrs. Arnesen, Christensen, & Smith, and Captain Larssen.

Conde de Churruca.—This new twin screw motor vessel, which was built to the order of the Sociedad Commercial de Oriente de San Sebastian by Sir W. G. Armstrong, Whitworth & Company, Ltd., England, was launched from the Walker shipyard last month. The vessel is of the twin-deck type with poop, bridge and forecastle, and has a raked stem and elliptical stern. She is 370 feet in length, 48 feet, 7 inches in breadth, 30 feet deep and is of 4,500 gross tons. Her propelling machinery consists of two sets of Armstrong-Sulzer Diesel engines, working on the two-cycle principle.

Sierra Morena.—The Burntisland Shipbuilding Company, Ltd., has launched the cargo steamer Sierra Morena, which was built for Danish owners. The vessel is of the single deck type, with a long bridge, and of 6,400 deadweight tons. She is 341 feet 6 inches long, 48 feet, 9 inches in breadth, and 27 feet, 3 inches in depth. She is built to comply with the highest classification of Lloyds.

British Viscount.—The British Viscount, which has been built and engined by Swan, Hunter & Wigham Richardson, Ltd., at their Neptune Engine Works, Newcastle-on-Tyne, sailed from the River Tyne on Monday, June 20. She is a large oil tank steamer, with all the latest improvements, built to the order of the British Tanker Co., Ltd., of London, being about 455 feet in length by 57 feet beam, and is designed to carry over 10,000 tons of oil. She has been constructed to attain the highest class in Lloyds Register, and is very fully equipped with the most modern and improved appliances for her service, including steam winches for working cargo and warping, installation of wireless telegraphy, Hele-Shaw steering gear, etc. The accommodation for the captain, officers, engineers and crew is of a very comfortable description, and there are a limited number of spare rooms. The propelling machinery consists of a set of double reduction geared turbines of the Metropolitan-Vickers Rateau type, supplied with steam by three large boilers fitted with Howden's forced draught. The auxiliary machinery in the engine room is driven electrically.

Mont Viso.—Steel screw steamer Mont Viso, built by Sir Raylton Dixon & Co., Ltd., at their Cleveland Dockyard, Middlesbrough, to the order of La Societe Generale de Transports Maritimes a Vapeur, Marseilles, has proceeded to sea for her official trials. The vessel has been built to a very complete specification and is of the two-deck type with bridge and poop combined and forecastle, her principal dimensions being 370′ x 53′ x 28′ 6″, moulded with a deadweight carrying capacity of about 7,800 tons on a light draft of water, and she has been constructed under special survey to receive Lloyds' highest classification, also to meet the requirements of French law, including fire extinguishing.

SHIPBUILDING AND REPAIRING SITUATION.

The situation in the shipbuilding and repairing industry on the Clyde, Scotland, shows no improvement. Nearly all shipyards and marine engineering shops remain open, but many of them may as well be closed, for four days per fortnight is but a fraction of the working capacity of any engineering shop or shipyard, and it is only the desire to keep their works nominally open and their staffs together that many firms have not closed down before now. Yet behind all this depression, so far as work is concerned, there is a definite feeling of confidence in the future. It is believed that as soon as the costs of materials fall to a reasonable level and wages questions are settled, there are very good prospects of obtaining further contracts. Another difficulty with which they are confronted is the coal strike. Their stocks of coal are nearly exhausted, and although their orders are small they cannot obtain anything like satisfactory deliveries. Further the long strike of the shipyard joiners is helping to hold up work, and vessels are having to be sent to foreign yards to have their joinery work completed.

During the month of May there were only five cargo carrying vessels launched on the Clyde, three of which were over 1,000 tons each. The total tonnage of these five was 21,905 tons. There were 14 other small vessels launched of a total tonnage of 22,750 tons.

IN THE NORTHEAST.

The situation on the North-east Coast may be shown by the following figures:

On the Tyne during May only four vessels were launched of a tonnage of 11,200 tons, as against 12 of 18,328 tons for the month of May, 1920. The total for the five months of this year is now 35 vessels of 102,966 tons, as compared with 38 vessels of 108,823 tons for the same period last year.

On the Wear during the month of May four vessels of 22,645 tons were launched, making 13 vessels of 61,427 tons for the five months of the present year, as compared with 134,018 tons for the corresponding period of last year.

There are about 170,000 adult workers unemployed on the North-east Coast, and approximately 26,500 adult workers on short time.

At the commencement of May there were no fewer than 226 vessels lying idle in the Tyne, the majority of them awaiting coal cargoes, and in May the total amount of coal shipped from the river as cargo was 109 tons, or 1,747 tons, including bunkers.

IN SPAIN.

Shipbuilders in various parts of Spain are opposed to the plan of the Minister of Public Works de la Cierva for permitting the sale of vessels constructed in Spain under Government subsidy on condition that the builders return the subsidy. Several of the builders have visited the Minister, pointing out to him loopholes in the scheme which, they argue, favor certain shipbuilders and is not likely to solve the shipbuilding crisis. The Parliamentary Committee, which has the subject in charge, is taking the shipbuilders' objections into consideration and probably will change the plan, making it of wider scope.

BUSINESS NOTES

A. G. Briese, 30 Church Street, New York City, has been appointed Eastern sales agent by the Consolidated Shipbuilding Corporation for their speedway gasoline engines, medium and high duty. The Consolidated Shipbuilding Corporation, Morris Heights, N. Y., formerly the Gas Engine & Power, and Charles L. Seabury & Company, are the originators and manufacturers of speedway engines, and at the present time it is stated the facilities available will allow the manufacture of four times the usual output without attempting to manufacture the motors on a production basis.

The new building of the Western Electric Company, at 395 Hudson Street, New York City, was officially opened last month, several departments of the company having already moved into their new quarters. The building is an eleven-story structure, with a total floor space of 706,000 square feet. The company's New York shops and the great supply divisions of the eastern district territory, which include New York, New Jersey, Pennsylvania and the New England States, and the International Western Electric Company will move into the new building as their quarters are completed. Several new inventions will be used for the first time in this building. Mr. Walter Drury is the New York sales manager.

Mr. John D. Hurley, president of the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Ill., sailed from New York City on the steamship *Olympic*, Saturday, July 16, for an extended trip throughout Continental Europe. Mr. Hurley was accompanied by Mrs. Hurley, his wife, and will make his trip one of combined business and pleasure. The Independent Pneumatic Tool Company are manufacturers of Thor Air and Electric Tools.

TRADE PUBLICATIONS

Electrical Products.—Catalogue No. 23 illustrating and describing the products of the Benjamin Manufacturing Company, N. Y., has just been sent out. This catalogue lists such material as sockets, attachment plugs, reflectors and reflector fixtures, signals, portable lamps, panel boards, water and moisture proof fittings and marine panels and cabinets.

Fire Protection Systems.—The latest bulletin of the Grinnell Company, New York, contains articles outlining the use of Grinnell apparatus and sprinkler systems where low pressure water only is available; examples of the application of the systems to industrial plants through the South are also given.

Low Pressure Expansion Joint.—The general construction of low pressure expansion joints recently developed by the Griscom Russel Company, New York, is clearly illustrated and explained in a bulletin issued by the company. These joints are of the low pressure type especially adapted for use on steam lines between the turbine and condenser of a power unit.

Pneumatic Tool Accessories.—A booklet covering all the various accessories used in connection with air tool service has been sent out by the Ingersoll Rand Company, New York, makers of "Little David" pneumatic tools. The booklet describes air hose, hose couplings, hose clamps and menders, air drill chucks, rivet sets and blanks, wire brushes, grinding wheels, rail drilling equipment and the like. Convenient tables of dimensions of all rivet sets and chisels are given.

Renewable Fuses.—The Trico Manufacturing Company, Milwaukee, Wis., is distributing a number of small envelope folders devoted to the illustration and explanation of the Trico renewable cartridge fuses. The renewable element consists of a fuse length surrounded by an arc choking powder which kills any gases generated and prevents violent explosions.

Electric Hoists.—A new bulletin devoted to descriptions and applications of electric hoists to industrial purposes has been issued by the Electric Hoist Manufacturers' Association of New York. The pamphlet contains numerous photographs showing various types of electric hoists and hoisting apparatus in actual operation in plants having to handle a wide variety of materials.

Characteristics of Copperweld Wire.—A bulletin has recently been issued by the Copper Clad Steel Company, Rankin, Pa., which includes the loading tables and the characteristics of copperweld wire. These tables afford complete information as to the diameter, cross section, breaking load, allowable tension, load per lineal foot, elasticity and resistance of stranded, solid-bare, and solid weather proof copper clad wire.

Engineering Service Talks.—A number of folders are being distributed by Warren D. Spengler, Inc., Cleveland, Ohio, which give a series of electrical service talks. The first folder explains the advantage of periodical tests of equipment insulation, the second, drying electrical equipment to restore insulation value, and the third emphasizes the importance of analyzing power costs.

Alarm Systems.—A pamphlet sent out by the Holtzer Cabot Electric Company, Boston, Mass., describes some of the electric apparatus developed by the company as a result of its forty-five years' experience in this industry.

MARINE SOCIETIES

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS

Navy Department, Washington, D. C.
President—Capt. A. J. Hepburn, U. S. N.
Secretary-Treasurer—Commander J. S. Evans, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.
Annual meeting and election, first Tuesday in October, other meetings at call of the President.

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National President—John H. Pruett, 423 Forty-ninth St., Brooklyn, N. Y.
National Treasurer—A. B. Devlin, 187 Randolph Ave., Jersey City, N. J.
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

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Treasurer—J. B. Sadler, P. O. Box 987, Norfolk, Va.
Executive Committeemen—G. W. Nusbaum, Washington, D. C.; A. H. Haag, Baltimore, Md.; John Thomson, Bethlehem, Pa.

NATIONAL MARINE ENGINEERS' BENEFICIAL ASSOCIATION OFFICERS

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National Secretary-Treasurer—Geo. A. Grubb, 356 Ellicott Square Bldg., Buffalo, N. Y.

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WE GUARANTEE that of this issue 6,450 copies were printed; that of these 6,450 copies, 4,900 were mailed to regular paid subscribers, 326 were provided for counter and news company sales, 283 were mailed to advertisers, 37 were mailed to employes and correspondents, and 904 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 64,500—an average of 7,166 copies a month.

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Enlarging Our Scope

WITH the main object of fighting for those conditions in the United States which will make it possible to successfully operate ships under the American flag, for otherwise they will not be designed and built in American shipyards, Marine Engineering has been gradually broadening its policy by adding more and more material relating to shipping legislation and ship operation.

In doing this we have in no way reduced the quality or character of the engineering articles, and we never shall. On the other hand the up-to-date naval architect and marine engineer knows that there is a close relationship between the construction of a ship and its machinery and the problems that must be met in maintaining and operating it. In order that he may design the most efficient and economical type of vessel he realizes that he must know the physical and traffic conditions of the berth on which she is to operate.

For the above reasons we are adding Shipping Age to our title. It does not mark a radical change in our editorial policy but, rather, it is only a step in the natural development of the scope of this publication. The war and reconstruction periods have brought new problems to shipping as well as to the industries and we shall meet them as they occur with the best articles that can be obtained from well known experts who are specialists in their particular field.

In making this change we believe that we are giving the subscriber to Marine Engineering an added service and that in the future the publication will be even more valuable to him than it has been in the past.

Marine Engineering has always stood at the top of the list of marine papers both in this country and in Europe and with this enlargement of scope it will stand pre-eminent as the *Marine Paper of the World.*

Buyers Marking Time

THE condensed opinion of a man who has just completed a world tour and who has made a thorough analysis of the conditions in all the principal cities in the interest of a steamship company is that the present depression in business is due to the action of buyers who are marking time in anticipation of further price readjustments. In this country the widespread agitation for reductions in the railway rates now in force on freight shipments undoubtedly accounts, in part, for the hesitancy of the buyers. It is known that a number of shippers have deferred moving goods in the expectation of lower transportation rates, in spite of the fact that there is no prospect of any early general reduction of rates.

However, the railroads and the Interstate Commerce Commission will probably reach an agreement in the near future regarding both domestic and export rates. Mr. F. W. Davies of the North Atlantic and Western Steamship Company has gone so far as to predict that there will be a decided revival of trading in the month of September and he bases this opinion upon the plans of leading Eastern merchants who are shaping their course to meet more favorable business conditions.

Government Contracts

THE Government has apparently suspended work on the major portion of the 1916 naval program and the Bureau of Construction and Repair in its monthly report posts the date of completion of these ships as indefinite. Congress authorized the construction of these vessels and the Navy Department executed contracts with the shipyards to build them. The shipyards entered into contracts

with hundreds of sub-contractors for machinery and equipment, and these sub-contractors in turn contracted for material.

We are in sympathy with efforts of the Government to economize, and acknowledge that it has a perfect right to scrap all programs that are under contemplation, but we are strongly opposed to using economy as an excuse for the suspension of contracts entered into in good faith. Where work has been started, and while it is under execution, a stoppage means financial loss and, in some cases, ruin. At this time it means that thousands of men must be laid off, personnel organizations must be broken up and equipment and material must be paid for and carried in stock.

If we do not enter into a satisfactory disarmament agreement, we will need these ships badly for the protection of our thousands of miles of seacoast. If we do arrive at an agreement, the position and wealth of this country demand that we supply as great a share of the international sea police force as any other nation. We will be criminally negligent in the present state of world affairs if we neglect to insure our country's safety and tranquillity, for we have not reached the stage where we may be sure that any nation or any group of men will arbitrate any question or issue that they have the power to enforce.

Criticism

CHAIRMAN LASKER told the House Committee on Appropriations that the Shipping Board fleet in the time it had operated had saved the country millions of dollars in freights and that if Congress and the press gave them half a chance they would put the Board on its feet. He is quite right in both instances. The Board has not only kept freight money in this country that would have gone abroad but it has, by holding its vessels at a high figure, prevented a series of financial shipping disasters that might have killed our merchant marine. It has been expensive for the taxpayer but our merchant marine is absolutely necessary and the Government is the only organization that is strong enough to carry the bag until normal trade is resumed.

Let us hope that Congress will grant the Board reasonable appropriations for it will cost us more in the end if it does not. But most of all let us hope that the press will do its part in educating the people on the relation of our ships to business prosperity rather than indulging in destructive criticism, which not only destroys our shipping but also the opportunity to market American time sheets abroad. Boiled right down, we cannot expect capital to invest in shipping ventures until we cease to poison public opinion with scandalous and sensational misrepresentations which give the impression that American shipping cannot be established on a profitable basis.

We venture to say that England's success on the sea is largely due to the support that it has received from the entire English people, and until America learns to give whole hearted backing to those men who make great personal sacrifices for the development of our shipping it has no one to blame but itself if our merchant marine is not successful.

In this connection, we cannot too strongly urge shipping men in their comments about their colleagues to give most careful consideration to the effect upon the opinion of the American public and the world of criticism or inferences that are not of the constructive sort. We are sorry to note that the new Shipping Board finds it necessary or politically expedient to establish a zero mark as an index of the efficiency of the previous Board. Admiral Benson fought a great battle, single handed, without proper support and it can do no good to belittle his work, for we all know him to be a game fighter representing the best type of our naval tradition. The new Shipping Board has already accomplished a great deal but there will be plenty of glory for it, and certainly more enthusiastic support, if it dates the achievements of the Shipping Board and the Emergency Fleet Corporation from 1917 instead of 1921.

English Recognition of Mr. Schwab

ONE of our English contemporaries, the Shipbuilding and Shipping Record, in referring to the testimonial dinner given to Mr. Charles M. Schwab by his former associates in the United States Shipping Board Emergency Fleet Corporation, expressed the wish that Great Britain had been represented at this function. It was pleased to state that, when the Allied Nations considered ships a vital factor for the safety of the cause and the preservation of our civilization, Mr. Schwab, when he was responsible for the carrying through of the great shipbuilding campaign in the United States, did fine work for which this reception was a fitting recognition.

The construction of our merchant marine was the greatest industrial achievement of the war and we believe that Mr. Schwab is prouder of the fact that he was director general of the Emergency Fleet Corporation when this work was accomplished than of anything else that he has ever done. The tribute from a representative English shipping paper will be greatly appreciated by Mr. Schwab and his friends, and especially so in view of the fact that the ships he constructed are now competitors of the British merchant marine.

Employment Bureau for Engineers

OF equal interest to both employers of professional men and to engineers of every grade of training and experience is the recent establishment of an employment bureau for technical men by the Federated American Engineering Societies, 29 West 39th street, New York, which represents a combined membership of about 50,000, including the best and most representative professional engineers in the United States.

This service, which is rendered free to either party by the Employment Bureau, means much more to an engineer than a mere method of securing work, important as that may happen to be. It means that the Bureau through its comprehensive classification of records compiled from the applications received, which must contain both educational and professional experience, will be able to designate the right man to fulfill the special requirements of any particular position.

Although the poet probably did not have the engineer in mind when he wrote "Full many a flower is born to blush

unseen," nevertheless there has been a vast number of technical men who have never had the opportunity to engage in the particular kind of work for which they were best suited and for that reason, in many instances, they have failed to succeed; and it is also true that there has been many a firm and many a project that has failed for no other reason than an inefficient personnel. Therefore we look upon this service as the establishment of a reserve and a reservoir of potential economic wealth which will be mutually beneficial to employee and employer.

Tax on Yachts and Motorboats

THE present tax of ten percent on all pleasure boats, if sold for more than $15, has had a destructive effect upon the yacht and motorboat industry. Not only has this industry fallen to a point where it is doing only about 30 percent of its pre-war business but, in view of the addition of a ten percent tax on top of the increased cost of labor and material, there are very few prospective purchasers in the market.

The tax is oppressive and discriminatory because the tax on automobiles, which is a competitive and much more powerful industry, is only 5 percent. They both furnish outdoor recreation but the yachtsman not only must pay 10 percent instead of 5 percent but he must also indirectly pay the special taxes upon the accessories and equipment which are installed in his boat.

When it is remembered that a total of 1,675 members of American yacht clubs volunteered their services to the Government in the great war and that their experience and skill as navigators and boatmen was invaluable, it ought to be apparent that the country should encourage this form of sport. The Naval Reserve needs the yachts and motorboats as well as the men who man them, and the Navy Department is well aware of the value of these craft as an adjunct to their warships.

But getting down to business facts, the tax is so oppressive that it destroys its own source of revenue. So long as it is retained the small boat industry will remain in its present stagnated condition. On the other hand, a far greater amount could be obtained through income and profit taxes if this oppressive burden did not stand in the way of the re-establishment of the yacht and motor industry on a firm financial and industrial basis.

Reduced Insurance

THE action of the Shipping Board in reducing the amount of insurance required to protect the balance due on vessels purchased from the Government should be highly commended. Although the new valuations, which are said to be $60 per ton for vessels of the lake type, $80 per ton for freighters and $100 a ton for tankers, are probably higher than those for corresponding ships on which foreign shippers are paying insurance, these new values for insurance will have a marked effect on the operating expenses.

While it might be good business to reduce still further the insurance charges of our pioneer purchasers, the values quoted above are probably about as low as the Board could safely go without special authority from Congress. As we see it, in case of total loss it will be better to replace a vessel from the Government's tied-up reserve—as we understand that these valuations are without prejudice to the original sales price—for it is very doubtful if our ships can be sold at the above figures. At any rate the Board would not have the authority to spend, say, $120 a ton to replace a ship that was insured for $80 and it would be ridiculous to expect shipping concerns, who, as Mr. Harriman puts it, were "game enough sports" to pay from $200 to $225 a ton for their ships, to contribute $40 a ton more.

It is to be hoped that the action of reducing insurance values indicates that the Board is also in favor of adjusting the prices paid by our pioneer purchasers of government ships. It may be necessary to get permission from Congress to do this, but whatever body has the decision should remember that these men did more than agree to take certain vessels off the Government's hands; they risked their money and did their best to help establish our merchant marine. Considering the scarcity of shipping talent, we can hardly afford to risk losing their cooperation by extracting our pound of flesh.

Internal Combustion Steam Power

AN English engineer who claims to be the inventor of the thermo-electric method of ship propulsion now proposes to revolutionize steam engineering and particularly marine engineering by a new system called the super-Diesel internal combustion steam compressor method. He claims for this method a combination of all the advantages enjoyed by the reciprocating engine, the Diesel engine and the electric drive and at the same time a great saving in the weight and first cost of the propelling machinery.

The system consists of a multi-cylinder Diesel steam compressor as a power generator and a triple expansion non-condensing reciprocating engine to drive the propeller shaft. This compressor is of a special design in which steam is compressed by the under side of the piston on the down stroke while the internal combustion process working on the top of the piston produces the power. The compressed steam then goes to a high pressure receiver and from there to the throttle valve of the non-condensing reciprocating engine. After passing through the engine it goes to a low pressure receiver at about 10 pounds pressure and from there it is returned to the steam compressor and is regenerated again into high pressure steam. Incidentally it is claimed that the auxiliaries, steering engine, winches, windlass and even the heating system can be operated in a similar way, taking their steam from the high pressure receiver and returning their exhausts to the low pressure receiver.

For the initial low pressure steam and for the makeup a boiler of about 100 gallons capacity per 1,000 horsepower is claimed to be all that is necessary, for due to the small number of working parts of the system and the reduced number of glands the amount of the makeup water, it is claimed, will be very small. The inventor states that the exhaust from his super-Diesel compressor is only about 500 degrees Fahrenheit and that this heat is utilized through distribution pipes to heat lag the steam reservoirs or receivers.

Having thus nicely outlined a closed system from which

little heat can escape he goes on to state that old iron merchants should get ready for a big business for there will be no more use aboard ships for such things as boilers, condensers, air and circulating pumps, feed pumps and their engines.

Despite the fact that Professor Unwin estimated that only from 0.44 to 0.51 percent of the indicated steam power of a compressor when used on a large scale can be realized on the shaft of a compressed air engine, we do not wish to scoff at or discourage this inventor who, in his patriotic enthusiasm thinks that he has discovered a means of securing a permanent maritime supremacy for the British merchant marine. Neither do we feel justified in predicting that a material cannot be found having the heat refracting power of firebrick together with the strength of steel, which requisites appear necessary for a successful gas turbine, but we would like to have a look at this wonderful compressor before making plans to dispose of our boilers and auxiliary machinery.

Lloyd's Register Returns

LLOYD'S shipbuilding returns for the quarter ending June 30, 1914, give an interesting array of figures on the world shipping tonnage, both afloat and building. They show that the self-propelled sea-going tonnage of steel and iron construction aggregates 22,386 vessels of 54,217,000 gross tons on June 30, 1921, as compared with 19,061 vessels of 42,514,000 gross tons on June 30, 1914. If we include sailing vessels and wooden steamers the tonnage is considerably greater but the ratio between 1921 and 1914 is practically the same. By countries these returns show that, neglecting sailing vessels and self-propelled ships of wood and concrete, the British merchant marine consists of 19,288,000 gross tons as compared with 18,877,000 gross tons in 1914, a gain of only a little more than 2 percent in seven years. The British Dominions collectively have 1,407,000 gross tons as compared with 543,000 gross tons in 1914. The United States have 12,314,000 gross tons of this type of vessels as compared with 1,837,000 gross tons in 1914. Japan has 3,063,000 gross tons as compared with 1,642,000 gross tons in 1914; France has 3,046,000 gross tons as compared with 1,918,000 gross tons in 1914; Italy has 2,378,000 gross tons as compared with 1,428,000 gross tons in 1914; Norway has 2,285,000 gross tons as compared with 1,923,000 in 1914; Sweden has 1,037,000 gross tons as compared with 992,000 gross tons in 1914; Denmark has 866,000 gross tons as compared with 768,000 gross tons in 1914; Holland has 2,207,000 gross tons as compared with 1,471,000 gross tons in 1914; Spain has 1,094,000 gross tons as compared with 883,000 gross tons in 1914; Greece has 576,000 gross tons as compared with 820,000 gross tons in 1914; Austria Hungary has nothing as compared with 1,052,000 gross tons in 1914; Germany has 654,000 gross tons as compared with 5,098,000 gross tons in 1914; the collective increase is about 27½ percent.

From these figures and the 6,199,468 gross tons under construction in the shipyards of the world today it would appear that very little encouragement for the shipbuilding industry is in sight and, if we cannot look forward to an increase in the volume of sea-borne trade, this outlook would indeed be dark. But there are some very vital facts which these figures do not show, and principal among these is the number of ships that are obsolete. Sir Owen Phillips has estimated this tonnage at about 8,000,000 and certainly the price at which some of these vessels have recently been sold appears rather low even for a ship breaker to offer. Lloyd's returns include everything that floats, but it is known that a large number of ships will never see service again. In the case of many more it would be cheaper to build new vessels than pay the high cost of repairing them. Furthermore, these returns do not show how many of these ships have damaged or inefficient machinery, in other words, how many will have to be re-engined and re-boilered. It does not point out that the increase in the use of oil fuel both on land and at sea has created over 3,000,000 gross tons of oil tankers which should not be included in a surplus comparison with the 1914 returns.

Finally, these returns should not give the world the impression that there is an over supply of all classes of vessels. For example, there are 2,000,000 tons less of passenger ships now than there were in 1914. This country has only 18 refrigerator ships and there are a number of special types of vessels of which there is not a surplus such as cable ships, light ships, ferry boats, etc., not to mention naval vessels which are not included in the above returns, which may constitute no inconsiderable portion of new shipbuilding contracts.

The Shipping Board Appropriation

IN cutting down the appropriation of $100,000,000 requested by Chairman Lasker for the operation and construction of vessels during the next six months to $48,500,000, Congress is adopting a policy that is "Penny wise and pound foolish." If Mr. Lasker is to succeed in transferring the government ships to private owners, he must have something more than ships to sell. That something is business over the new trade routes and increased business over the old. He must do what only the Shipping Board can do, aid our private owners to build themselves up to a position where they can buy the ships.

"If the Board does not do this," Chairman Lasker says, "we shall not have any operators or owners left in America who can buy these boats." Exclusive of wooden ships, there are 1,440 vessels in the Government fleet which is far in excess of the number operated by any of the old established and experienced lines in England. We feel that we are not going too far in saying that the task of successfully running this vast fleet would stagger the most efficient shipping concern and while we are not advocating that Congress continue indefinitely to grant large appropriations to the Shipping Board, we do believe that Chairman Lasker should be given, at least, a sporting chance of making good.

He took this job, at a great financial sacrifice, and after the President was unable to find another man of large caliber available. In addition to this, it is a time of unprecedented depression all over the world. Congress should make up its mind either to take the ships out and sink them or to grant a reasonable amount to keep them going.

Relation of Our Merchant Marine to Business

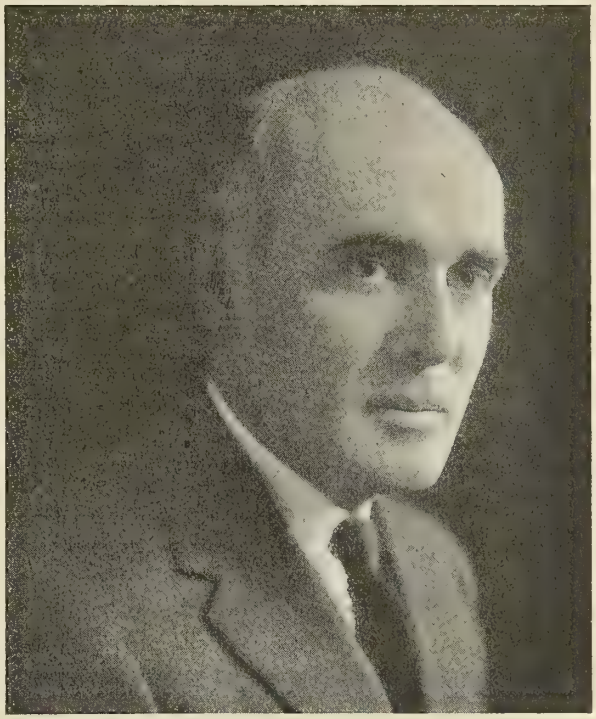
By Francis H. Sisson*

Under the stress of present readjustments, when economy and efficiency are the watchwords of the hour, we must be very careful not to lose our sense of proportion, and above all not to let distressing details obscure our vision of paramount principles. In a short-term period of deflation, we should not lose sight of the long-term constructive expansion which has been occurring in this great, virile, under-developed land of ours, since its settlement, and which will continue for centuries more. That, in fact, should be our point of view regarding all fundamental economic factors, not the least of which is our new merchant marine in respect to its bearing on our business prospects.

UNFORTUNATE as the mismanagement of the Shipping Board may have been, scandalous as may have been the waste of our heavily burdened taxpayers' money in acquiring a large merchant marine as a war necessity, they should not be confused with the vital, underlying question of the maritime future of this nation. We should remember that a large merchant marine, successfully operated by private interests, will play a very important part in our future prosperity.

Great Britain's Leadership

Great Britain's wonderful series of commercial conquests led directly to political empire in many countries. Her adventure in India had its origin in the enterprise of a great trading company and the initiative of her merchant sailors won for her, one after another, colonies and dependencies throughout the entire world. Her fleets were found in the most remote ports and one by one her sons established themselves in trading outposts in every rich dominion. Her iron and coal, her wool and other raw materials, coupled with industrial skill, gave scope for the development of manufactures. As her wealth grew, her interests abroad multiplied, and London became the financial center of the world, as well as the greatest of all clearing houses for commodities of every description from every country in the world.



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Francis H. Sisson

Prior to 1914 Great Britain's position in shipping, in finance, and in trade was not seriously challenged by any other country, although Germany was striving to overtake her by efforts that were directed with great intelligence and combined all the powerful economic resources of that nation. Leadership in Germany had a complete comprehension of the elements that must form the basis of successful international commerce—a great merchant marine, foreign investments, banking and trading organization, highly developed domestic industries, and the control of supplies of raw materials, as far as possible, in the primary markets of the world. Her success in these efforts was so great that it will always be surprising to the future generations that she should have been willing to risk her assured position in the costly and ruthless speculation of the great war.

*Vice-president of Guaranty Trust Company of New York.

Must Decide Future Policies

The lessons of this record of the past are clearly written for those who study the present position of our own country. The United States, blessed with resources both natural and industrial that are beyond comparison, richer and more powerful than any other country, must now make the great decision as to her future policies. All the weapons for peaceful and legitimate leadership are within her grasp. The war has strengthened the United States where she was weak. Her merchant fleet employed in foreign trade in 1913 was only 1,019,155 tons. Now it is second only to that of Great Britain and comprises some 15,000,000 tons.

Since our earliest days as a nation it has been a tradition, carried almost to extreme, that we should maintain a position of aloofness in international affairs, and this attitude has influenced our policies towards foreign trade and shipping as well. We have always had a foreign commerce, but never as a primary interest, as in Great Britain and Germany, where such trade has been vital to them for many years. Our own domestic market has been so great that it absorbed by far the greater percentage of our production of every kind and, similarly, the opportunities at home for the use of capital for the development of our abundant resources have not only absorbed all our own surplus funds for investments, but have also drawn upon the capital of other countries, Great Britain especially, to a total of billions of dollars.

Financial Position Changed

It is true that mines in Mexico, Chile and Peru, the meat freezing plants in Argentina, Uruguay and Paraguay, and the paper industry in Canada, for example, have attracted several hundred millions of our investments abroad, but we were heavily indebted to other countries for capital they had loaned to us during many years. Today the change in this financial situation of the country is very marked. We have rebought a large proportion of our foreign-owned securities and, in addition, have loaned about fifteen billions to foreign governments and to municipal and private creditors, mainly in European countries.

The Federal Reserve Act has given us a foreign banking organization that is quite adequate for the needs of our international position and is constantly being extended. The large American banks have numerous branches abroad, and in every country there are direct banking connections with New York. Whatever may be the development of our foreign trade, it will surely be accompanied by a similar growth and strengthening of this great financial organization, upon whose service must rest the orderly and successful conduct of overseas commercial transactions.

Merchant Marine Revived

The record of the wonderful rebirth of our merchant marine is so recent and striking that it is known to everyone. For years we had been lamenting the fact that the glory of our great fleets of speedy clipper ships, which formerly carried the American flag to every port, had passed from the seas. But every effort to reestablish a merchant fleet had been defeated by a provincial political attitude towards the problem or by our national indifference to our position as a trading nation dependent upon commercial rivals for the transportation of our exports and imports.

Transportation is the link between the producer and the consumer—the means of bringing the goods to the ultimate buyer. More than ninety percent of the exports and imports of the United States are carried by water. America's future prosperity, therefore, lies largely on the seas. Shipping is the prime factor of international trade, and that nation is best equipped for such trade that has the best ocean-carrying facilities. For the first time in more than half a century the United States is in sight of the long-desired goal of transportation for the bulk of American products in American owned and operated vessels.

American vessels carried 94.2 percent of our imports and 86.5 percent of our exports in 1830. In 1860 these percentages had fallen to 60.1 and 70 percent, respectively. This diminishing continued until in 1910 only 10 percent of our imports and 7½ percent of our exports were carried under our own flag. The shipping losses of the Civil War depleted our fleets, and the absorption of our interest in the development of our internal resources and the competitive advantage held by Great Britain in the production and control of iron and steel ships led almost to our complete withdrawal from the high seas.

Our shipping legislation also, however well intentioned, actually operated to handicap the growth and movement of American owned shipping through the imposition of requirements and restrictions that rendered costs of maintenance relatively higher than those of our competitors. The exigencies of the war, however, forced upon us the construction of an adequate fleet and thus rounded out the national equipment for primacy in international commerce.

Foundation for Foreign Trade

Now we have all the foundation stones for any international trade structure that we may decide to erect. We have ships, a worldwide banking organization, illimitable capacity for production of both raw materials and manufactures, and capital resources far beyond any competitor. We have ceased to be a debtor nation and, in addition to a record of actual favorable trade balances of billions for the last few years, we shall have an invisible export represented by interest on the vast sums that have been loaned abroad.

High prices have been an important factor influencing this wonderful record of exports, but in spite of that element, the figures of our present trade disclose an unusual story of commercial activity. Vastly increased capital, ample shipping, and an enormous foreign trade were all the immediate result of the stimulus of the war, combined with our exceptional resources as an agricultural and manufacturing nation.

Courageous National Policy Needed

We are now at the parting of the ways. What are to be our policies in this new relation which we hold in the world of trade? All of the elements required to control and extend our commerce are at our command. Are we in the mood to seize this greatest of all our opportunities?

In fact, we must go forward, or we shall inevitably be forced to retreat from our present position with heavy losses all along the line—in shipping, banking and trade. We are already vigorously challenged by competitors in foreign markets. A courageous national policy of legitimately aggressive development of all these newly coordinated resources for the conduct of foreign trade is essential. Without constant initiative and positive effort we shall gradually be driven out of our advantageous situation.

There is no one American—merchant, manufacturer, banker, farmer or laborer—who has not some stake in this struggle. Our sales abroad of two billion dollars' worth of food products annually is a fact of importance to every farmer, either in direct interest or in effect upon prices. Exports of two hundred million dollars' worth of tobacco and more than a billion dollars in value of cotton add force to this argument.

Further, our vast industries when fully employed now produce such a surplus over domestic demands that loss of a foreign outlet for this surplus would mean serious labor depression. It is no longer true that we can look with comparative indifference upon our exports of manufactured articles as comprising too small a part of our total trade to be a matter of serious concern when they fall off. For many years the ratio of exports of manufactures to our total manufacturing production has been increasing, until now it has reached an amount that probably spells the difference between prosperity and failure in many industries.

Duty Rests on All

The variety of our foreign trade is now so wide that an excess of production over consumption reacts upon every class of our population. The duty, therefore, of supporting our foreign trade in this time of readjustment to the more permanent conditions of the future, rests on every individual citizen—whose welfare and prosperity are not independent of the economic position of his country.

The fact that the time of our national political and economic exclusiveness has passed is being more impressively illustrated every day. We have done a great foreign business in the past, but we cannot expect the conditions of that business to remain stationary. We have sold vast quantities of our commodities to customers outside of our own country; we have extended them liberal credits and loaned them much capital. But it is obvious that there must be some limit to their buying power unless we in turn purchase what they have to sell in quantities equal to their purchases of goods and capital from us.

If we go on taking measures to prevent the sale of foreign commodities in our country, if we try to erect barriers which retard the flow of commerce, we will in the long run handicap ourselves and work incomparable injury to our future prosperity. Already we are seeing the products of field and factory piling up in granary and warehouse. The real problem, therefore, is the maintenance of the volume of our trade.

The future rests not so much on government and politics as upon the wisdom and sagacity of business men. Foreign exchange rates were "unpegged" by the governments concerned in their regulation in March, 1919, and in April of the same year it was announced that the United States would make no further advances to foreign countries. Thus the business of financing our foreign export trade is again in the hands of the American people without expectation of either the interference or the help of the United States

(*Concluded on page* 656.)

The Egyptian Cotton Controversy

Alexandria Episode Discloses Monopoly for the Exclusive Benefit of the British Merchant Marine

By Winthrop L. Marvin*

WHEN, more than a few years ago I was constrained to leave the decks and rigging of the fishing craft, the coasters and the tall square-rigged East Indiamen, where most of my active boyhood had been spent, for the pursuit of a different kind of learning than the sea had taught me, one particular vexation which I met in the college halls was a solemn book on political economy written by an English author from a very insular standpoint—how it came into a Yankee institution I could never understand.

This exotic work propounded, among other things, that the British people owed their great merchant marine solely to their national policy of "laissez faire," or, in other words, to free trade—that all that Britain asked was to meet her competitors "on even terms," "without artificial aid," in a spirit of "a fair field and no favor." It happened that I had direct information from ship merchants of my native port of the way in which Lloyd's with its powerful discriminations was driving the last of our Yankee clippers from the seas and I had acquired also some concrete facts concerning British steamship subsidies. All of this information was somewhat indignantly related in the presence of the professor and my classmates as an example of what "a fair field and no favor" had actually meant in maritime history. Whether it was my youthful emphasis or the unmistakable sea tan and rolling gait of the briny atmosphere from which I had emerged, I know not—but at the end of the term the offending British text book had disappeared from the curriculum.

A Fair Field, Indeed!

So I cannot help smiling reminiscently as page after page of this present Egyptian cotton situation unrolls. No "artificial aid," a spirit of "a fair field and no favor," indeed! If there ever was a hard-and-fast monopoly for the exclusive benefit of British shipping, this Alexandria episode is certainly disclosing it—and it cannot be characterized as a mere reprisal for alleged discriminations of the Jones merchant marine law, for the Alexandria monopoly was in full swing years before the Jones law was ever heard of.

Undoubtedly we have not yet finished with this affair, for our Shipping Board, in the first round of its encounter with the Liverpool conference lines, has won only a half way victory, if any real victory at all. Let us review the various stages of the proceedings: First, the American (independent) Line, of the Harriman shipping interests, was told last year, when it applied at Alexandria for at least a part of the many thousands of bales of Egyptian cotton bought for the New England mills, that not a pound of that cotton could be sent over in American ships—that it had been going, and was to continue to go, to Boston or New York in nothing else than British bottoms. That is to say, this old-time maritime monopoly was absolutely sacrosanct!

Shipping Board, Lowest Bidder

But the American ambition to transport American property was not so easily downed. When the proposals were opened at Alexandria last May for the shipment of this year's cotton crop, there was consternation at the discovery that the American Shipping Board was the lowest bidder, not only for Egyptian cotton destined for the mills of the United States but also for cotton destined for the mills of the United Kingdom. In cold figures, the American bids were 40 shillings per ton for the United States and 25 shillings for British ports, while the Liverpool conference bids were respectively 60 shillings and 40 shillings.

Of course, if actual, as contrasted with mere rhetorical, "fair play" had prevailed, the contract for the shipment of the entire Egyptian cotton crop for the period from September 1, 1921, to August 31, 1922, should have been straightway turned over to American steamers. But that is not the way the thing is done. Though the Egyptian producers wished to accept the American ships with their far more favorable freight rate, the British interests dominant at Alexandria would have none of it. Even when the Shipping Board offered a compromise proposition and declared that it would be content, if the American part of the business were awarded to American ships, to leave the British business to British ships, the olive branch was flatly rejected by the Liverpool lines' conference.

Partial Compromise

Then, of course, there ensued the deadlock which the subsequent meetings of Shipping Board representatives and British steamship representatives in London could not readily resolve. All that the British side will consider, up to this writing, is that American vessels may be vouchsafed, say, perhaps fifty percent of the Egyptian cotton shipped direct to the United States but the Americans can have no share of the considerable quantities which are trans-shipped via Great Britain. Thus the situation stands. One important interest, apparently, is quite forgotten. That is the American manufacturers who purchase this Egyptian cotton for use in their own machinery. These are the men who have to pay the bills. They can have their cotton delivered at a cost of 40 shillings per ton in American ships, but the Liverpool lines demand 60 shillings. What is especially disappointing is that cable advices declare that the Cunard Company is one of the British concerns most insistent on retaining the indirect cotton trade to the United States as a British shipping monopoly. This is a singular attitude for the Cunard management to take, in view of the extent to which its own ships have for many years participated in American commerce. What would be the reaction of this old British company to a demand that all American cabin travelers to Europe sail exclusively under the American flag?

Liverpool Lines Responsible

Is the Egyptian cotton episode destined to prove the Bunker Hill of a lively maritime conflict, which might be a long and a costly one but which could have but one ending? There are various reassuring circumstances. First, this unfriendly discriminative attitude toward American ships is not the result of an official act—it has no governmental significance. It embodies simply the arbitrary course of the Liverpool lines, which are alone responsible. Egypt is not, formally at least, a British possession. If it were, American public sentiment would not oppose an effort to reserve the carrying trade between Egypt and Great Britain entirely to British ships, precisely as we reserve our trade with Porto Rico and Hawaii and presently will reserve our trade with the Philippines. But though we maintain inviolate the coastwise shipping policy of the fathers of the republic, we make no effort to confine to American ships the trade of Porto Rico with Europe or of Hawaii with Japan. We rightfully

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regard this as an international commerce, open to the ships of all the world.

There is no precedent whatever in American law or practice for the policy of exclusion which the Cunard Company and the other Liverpool conference lines endeavor to impose on American ships plying in the trade between Egypt and this country. A comparable act would be an attempt to forbid the export of our own Southern cotton to Liverpool and Manchester unless it were shipped in American steamers. Not only is such a policy not tried or contemplated but when the Lancashire spinners stipulated that their own purchases of our Southern staple must be delivered in none but British ships, and insured by none but British underwriters, Americans regarded these British manufacturers as acting within their rights, though scarcely in accord with the economic principles of Bright and Cobden.

American Manufacturers Pay Extra Freight

Gradually the American people and their lawmakers are going to learn how jealously each of the maritime countries of Europe insists on guarding and promoting the interests of its national merchant marine—the one industry left virtually unprotected in overseas commerce by the United States. Just recur to this Egyptian cotton trade: The Egyptian fibre—of a length and fineness inferior to our own Sea Island product but superior to the ordinary upland cotton—is an essential material for the manufacture of certain valuable cotton fabrics, in which the mills of the United States have made extraordinary progress. This progress the rival manufacturers of Great Britain cannot prevent, but the shipowners of Great Britain—the Cunard and other Liverpool lines—compel American manufacturers to bear the added cost of having their Egyptian cotton supplies trans-shipped via British ports, instead of being brought direct, forbid direct shipments to America and hamper our manufacturers by levying a 50 percent higher freight rate than the rate paid by the American vessels. Until the Shipping Board made its present determined fight, that was the actual American experience.

Now let us be wholly reasonable about this. If Great Britain, our chief manufacturing and maritime competitor, can so handle the ships of her vast mercantile marine as to force our commerce and our manufacturers to pay the tribute of discriminative freight rates or trans-shipment delays and costs on the materials or products of our greatest manufacturing industry—for in manufacturing America is easily supreme—Great Britain is entitled to do so if she can and as she has actually been doing in many more directions than this Egyptian cotton trade. But there is this outstanding fact, that we Americans will prove exceedingly weak and short sighted, if we continue to permit Great Britain to do this, now that for the first time in half a century we possess a great merchant shipping of our own.

Importance of Sea Power

I am not writing in any denunciatory mood toward the British shipowners, or manufacturers, or merchants, or their Government. Our kin overseas are sharp, shrewd men with a most admirable devotion to the welfare of their own race and country. Their dearest ambition has been to rule the ocean commerce of the world, because they realize that control of the ocean is of immense consequence in peace or war. The incalculable value of such sea control was vividly impressed upon the American nation in 1914, when Great Britain and Germany, who between them were carrying most of our imports and exports, clashed in arms, to the paralyzing of our sea-borne trade and the ruin of a host of our farmers, manufacturers and merchants. The immense importance of sea power had been demonstrated on a smaller scale to our own heavy cost a dozen years before, when Great Britain, our principal carrier, in her South African war had been able suddenly and sharply to advance her freight charges on our export and import trade, so that, in effect, the American people provided out of their pockets a large share of the money required to defeat and destroy the Boer republics.

These are two rather unfortunate passages in our national history. They are not going to be repeated, if the American nation upholds its Government in vital issues like this of the Egyptian cotton trade. There will undoubtedly be other points of difference and conflict before the other nations of the world finally realize that the United States is tremendously in earnest in its determination to maintain a merchant marine of its own capable of carrying the major part of its own ocean commerce. We do not begrudge other maritime peoples the possession of adequate merchant shipping facilities, with the indispensable building and repair yards, and a full force of seagoing officers and men. It is just as unfair and imprudent that any one nation should monopolize the sea carrying business of the world as that any one nation should maintain an army or a navy strong enough to overawe the world. Such an overwhelming power, on either sea or land, does not make for peace or good will among the peoples and the governments.

The 10,000,000 gross tons of registered shipping which the United States will possess when its wooden steamers are disposed of will equal substantially one-half of the overseas tonnage of Great Britain. These 10,000,000 gross tons will suffice to convey about 60 percent of the entire volume of goods which we sell to or purchase from the other countries of the globe. There is nothing sinister or menacing in the maintenance and gradual increase of a merchant shipping of this magnitude. It threatens no domination of the trade or the peace of any nation—and assuredly we shall accept no domination over our own.

Relation of Our Merchant Marine to Business

(*Concluded from page* 654.)

Treasury, except such as may be given by the revived War Finance Corporation.

The American dollar now stands at a premium in every important financial market of the world. And, in view of our foreign trade balances, therefore, an imperative duty rests upon every American who would see his country maintain its prosperity to take thought of how its future foreign trade may be properly maintained and profitably transported. Surely we have the energy and intelligence to solve the problem.

New Combustion Recorder Maintains Double Analysis of Flue Gases

A RECENT development in combustion control is embodied in the new type instrument known as the Duplex Mono recorder which maintains a continuous record of the carbon dioxide content and also the percentage of combustible gases present in flue gas. To obtain the highest efficiency from the operation of a furnace, the firing must be so adjusted that a proper balance between these two factors is maintained. The boiler from which the analysis shown in Fig. 1 was taken was operating at about its most efficient point as is evidenced by the high carbon dioxide content indicated by the white area and the low percentage of the combustible gases present represented by the light shaded area between the white and dark portions of the chart.

The instrument itself shown in Fig. 2 does not make use of any mechanical means to force the gas through the apparatus, mercury being used instead, which also performs

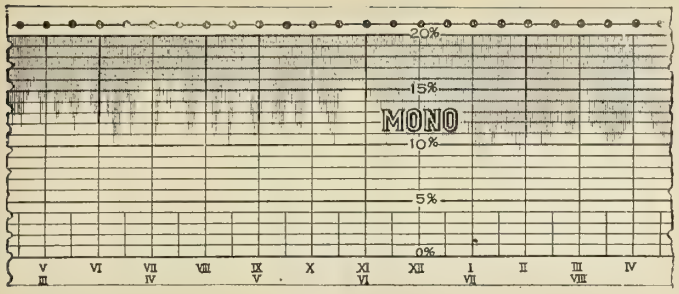

Fig. 1

the function of valves. The samples analyzed for carbon dioxide and combustible gases combined are passed through an electric furnace where the combustible gases, carbon monoxide, methane (CH_4) and hydrogen are converted into carbon dioxide and water. When there is not sufficient oxygen in the flue gases to oxidize the combustible gases, the necessary oxygen is supplied by copper oxide placed in the electric furnace for that purpose. Ordinarily, however, the necessary oxygen is taken from the flue gases, which almost invariably contain sufficient free oxygen, the copper oxide acting merely as a catalytic agent.

The carbon dioxide originally in all samples as well as that formed by the oxidation of carbon monoxide and methane (CH_4) in the alternate samples which pass through the electric furnace is removed by passing the gas through a caustic potash solution. Water formed in the electric furnace through the oxidation of hydrogen and methane in alternate samples is condensed. The analyses for carbon dioxide alone are accurate within 1/10 of one percent. The indications for combustible gases not being intended for accurate measuring purposes are exaggerated on the chart as is desirable in a danger signal.

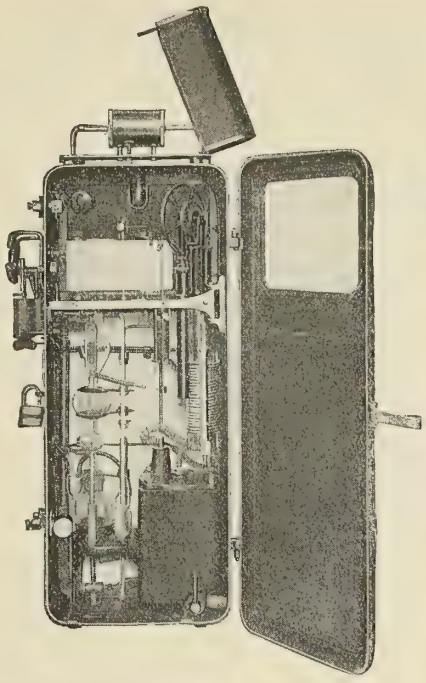

Fig. 2

The records thus made by the instrument make clear to the firemen and to the plant executive the heat and combustible gas losses at any period during the operation of the boiler. No limit should be placed on how high the carbon dioxide should be kept by the fireman provided that he avoids combustible gases in the flue. However, the best balance to be maintained is shown in Fig. 1. In any case where the combustible gases appeared at high or low percentages of carbon dioxide, the chart shows that they were promptly detected and eliminated.

Refrigerator and Cargo Steamer City of Pekin

Ellerman Lines' New Combination Steamer for the Eastern Trade—'Tween Deck Space Used for Refrigerated Cargoes

IN the single screw steamer *City of Pekin,* recently built by the Palmers Shipbuilding and Iron Company, Ltd., Hebburn, Eng., for the eastern trade of the Ellerman Lines, a distinctive feature is the provision made for the carriage of delicate refrigerated cargoes in Nos. 2, 3, 4 and 5 main 'tween decks. Figs. 1 and 2 show the general arrangement of the vessel which is of the two deck type with erections above the upper deck consisting of a prolonged poop and a combined bridge and forecastle with machinery located amidships. This arrangement of erections, rather than a complete shelter deck, is favored for vessels intended for the eastern trade because of the benefit derived by reduced Suez Canal tonnage measurement.

There are three cargo holds forward of the machinery space and two cargo holds and a deep tank (the latter also adaptable for cargo) aft. No. 3 hold can be employed as bunker space when so desired. The entire capacity of the erections is also available for cargo except such portions amidships as may be utilized for auxiliary bunkers. Permanent bunkers are built in the structure within the machinery space with a total capacity of 260 tons. Fuel oil is carried in the double bottom tanks.

Propelling Machinery

The propelling machinery consists of a set of turbines of the Parsons impulse reaction type driving a single screw through double reduction gearing. The turbines consist of one high pressure, one intermediate, and one low pressure geared to the propeller shaft, the high pressure and intermediate working tandem.

One high pressure astern turbine is incorporated in the intermediate pressure casing and exhausts into a low pressure astern turbine incorporated in the low pressure casing. The total astern power developed is about 70 percent of the full ahead power.

The ahead turbines are capable of developing the equivalent of 3,600 indicated horsepower at about 80 propeller revolutions per minute, at sea, under full load service conditions, but have a reserve power of 5 to 6 percent for emergency use.

The boiler installation consists of three single ended boilers of the usual cylindrical marine return tube type which are designed for a working pressure of 220 pounds per square inch. All boilers are provided with Howden's system of forced draft and are fitted with superheaters of the smoke tube type. The furnace fronts are constructed to burn oil exclusively, coal exclusively, or coal in conjunction with oil. The oil fuel installation is fitted complete in the machinery space, including the tanks, piping, pumps, heaters and filters and burners.

Auxiliary Machinery

The following auxiliary machinery was furnished the vessel by the firms indicated:

Refrigerating machinery by the Liverpool Refrigeration Company, Limited.

Steam windlass and electric lighting unit by Messrs. Clark, Chapman & Company, Limited.

Steam steering gear of the Wilson-Pirrie type by John Hastie & Company, Limited.

Refrigerator and Cargo Steamer City of Pekin

General Information

Service: Eastern Trade — Cold Storage, General Cargo.
Builder: Palmers Shipbuilding and Iron Co., Ltd., Hebburn, England.
Owner: The Ellerman Lines, London, England.

Characteristics

Length, overall.....461′ 3″
Length, B. P.....442′ 6″
Breadth, molded ..... 58′ 6″
Depth, molded, to upper deck..... 34′ 3″
Draft, loaded..... 28′ 8″
Draft, light .....
Block coefficient.....
Midship section coefficient.....
Longitudinal coefficient.....
Speed, loaded, knots, designed.....12
Cruising radius, nautical miles.....
Framing .....Transverse
Class: 100 A. 1 Lloyds.

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull.....
**Weight Propelling Machinery.....
Deadweight Capacity..... 11,200
Displacement .....

(In tons of 100 cubic feet)

Gross register..... 6,960
Net register..... 4,426
Underdeck 6,704

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.
**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez	.....	.....
Panama	.....	.....

Equipment

2 Bower anchors, stockless..... 77 cwts.
1 Bower anchor, stockless..... 65½ cwts.
1 Stream anchor, ex. stock.... 22 cwts.
1 Kedge anchor, ex. stock.... 10 cwts.
Chain cable, 2 7/16″ stud link...300 fms.
Stream line, 5″ steel wire.....120 fms.
Towline, 5¾″ steel wire.....130 fms.
(2) Hawsers, 8″ Manila, each..100 fms.
(2) Warps, 8″ Manila, each....100 fms.

Rudder

Area .....
Dia. Stock..... 12″
C. Press. abaft C. L. pintles.....

Complement

Deck officers..... 4
Deck crew..... 30
Engineer officers 8
Engineer crew 39
Purser's and steward's department..... 7
Total officers and crew. 88
First-class passengers..... 8
Second-class passengers.....
Third-class passengers.....
Total passengers..... 8
Total complement 96

Handling Equipment

	No.	Type	Capacity	Length
Masts	2	Pole	.....	.....
Derrick posts	4	Steel tubular	.....	.....
Booms	2	wood	7 tons	33′ 0″
	2	wood	7 tons	36′ 0″
	6	wood	10 tons	40′ 0″
	3	wood	10 tons	50′ 0″
	3	wood	12 tons	45′ 0″
	1	wood	40 tons	.. ..

Deck Machinery

Steering Gear, steam-telemotor control.
Windlass .....Steam
Capstans .....
Winches (2) 7x10
Winches (8) .....7 x 12
Winches (2) .....8 x 12

Life Saving Equipment

	No.	Type	Length
Lifeboats	2	.....	26′ 0″
Lifeboats	2	.....	24′ 0″
Dinghy	1	.....	20′ 6″
Gig	1	.....	20′ 6″

Propelling Machinery

Boilers

Number 3
Type .....Single ended Scotch
Length .....
Width or Diameter .....
Furnaces .....
Fuel .....Oil or Coal
Draft .....Forced
Total heating surface, square feet.....
Total grate surface or furnace volume.....
.....
Superheat, degrees F.....
Working pressure, lbs. per sq. in.....220
Normal fuel consumption:
Per day, tons.....
Per horsepower hour, pounds.....
Normal steam production:
Per hour per pound of fuel.....lbs.
Total per hour.....lbs.

Engines

Number .....1 set
Type, Parsons impulse reaction type, double reduction geared turbines.....
Horsepower, shaft 3,300

Propellers

Number 1
Type .....
Weight .....
Diameter .....
Pitch .....
R. P. M.....80
Projected area .....
Developed area .....

Auxiliary Machinery

Machinery Space

Condenser (1), surface condensing type.
Auxiliary condenser (1), 700 sq. ft. cooling surface.
Evaporators (1), 35 ton, 95 sq. ft. surface.
Distiller .....
Filter, feed control tank Cascade type.
Feed water heater (1), 145 sq. ft. surface.
Fuel oil units (2) .....
.....
Pumps .....
Main feed (1 pair), 12x9x24.
Aux. feed (1), 7x5x12.
19″ centrifugal circulating (1), 9x9.
Dual air (1), 12x22x15 & 17.
General service (1), 10x6x10.
Ballast (1), 10x10x10.
Fire and bilge (2), 8x9x18.
Evaporator feed (1), 4x4x6.
Forced lubrication (2), 8½x7½x15.
Forced lubrication (1), 5½x5x12.
Water service (2), 7x8x18.
Fuel oil transfer (1), 7x8x15.
Refrig. circulating (1), 8x8x8.
96″ forced draft fan, 8x6 engine.
Ash hoist engine (1), 4½x5.

Refrigerating Machinery

.....
.....
.....
.....

Electric Equipment

Generators (1), driven by 8x8 engine.
Radio .....Marconi
Emergency .....

Holds

No.	Length	Hatches
1.....	71′-3″	27′ x 16′
2.....	84′-0″	30′ x 16′
3.....	27′-0″	21′ x 16′
4.....	72′-0″	27′ x 16′
5.....	66′-11″	27 ′x 16′
Deep tank.....	24′-0″	9′ x 10′

Capacities

Cargo Space

Compartment	Cu. Ft.
Total gross capacity, cargo spaces below upper deck.....	575,400
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.....	
.....	
.....	
.....	
.....	
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.....	

Refrigerated Space

Compartment	Cu. Ft.
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Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons
Permanent bunkers			260
Portable bunkers			2620
Total			2880
.....			
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.....			
.....			
.....			
.....			
.....			

*.....cu. ft. per ton; .....gals. per bbl.

Tanks

Compartment	Cu. Ft.	Tons F. W.	Tons S. W.
Water ballast spaces, total.....			2,300
(2) F. W. tanks on upper deck, 27.....			
.....			
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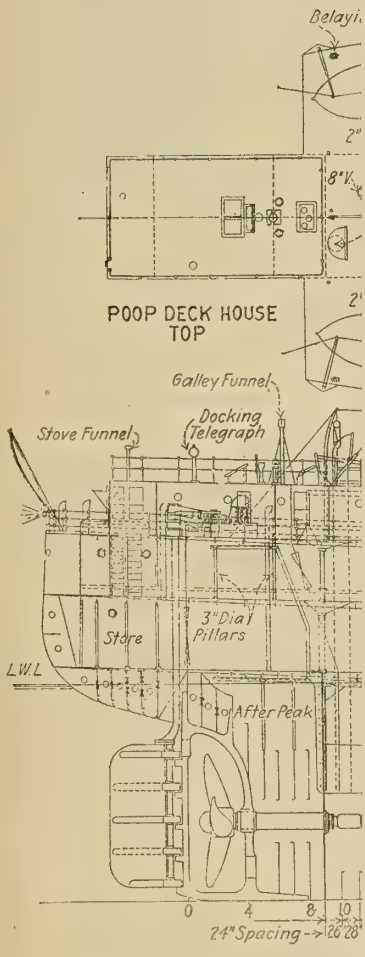
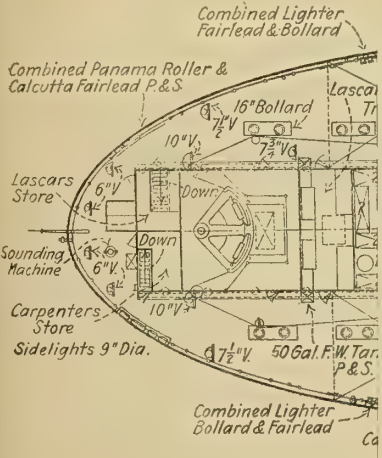

Belayi
2"
8"V
2"
POOP DECK HOUSE TOP
Galley Funnel
Stove Funnel
Docking Telegraph
Store
3" Dia Pillars
L.W.L
After Peak
0
4
8
10
24" Spacing


Combined Lighter Fairlead & Bollard
Combined Panama Roller & Calcutta Fairlead P.&S.
16" Bollard
10"V
Lascars Store
6"V
Down
Sounding Machine
Carpenters Store
Sidelights 9" Dia.
50 Gal. F.W. Tar
P.&S.
Combined Lighter Bollard & Fairlead

REFRIGERATOR AND CARGO STEAMER CITY OF PEKIN

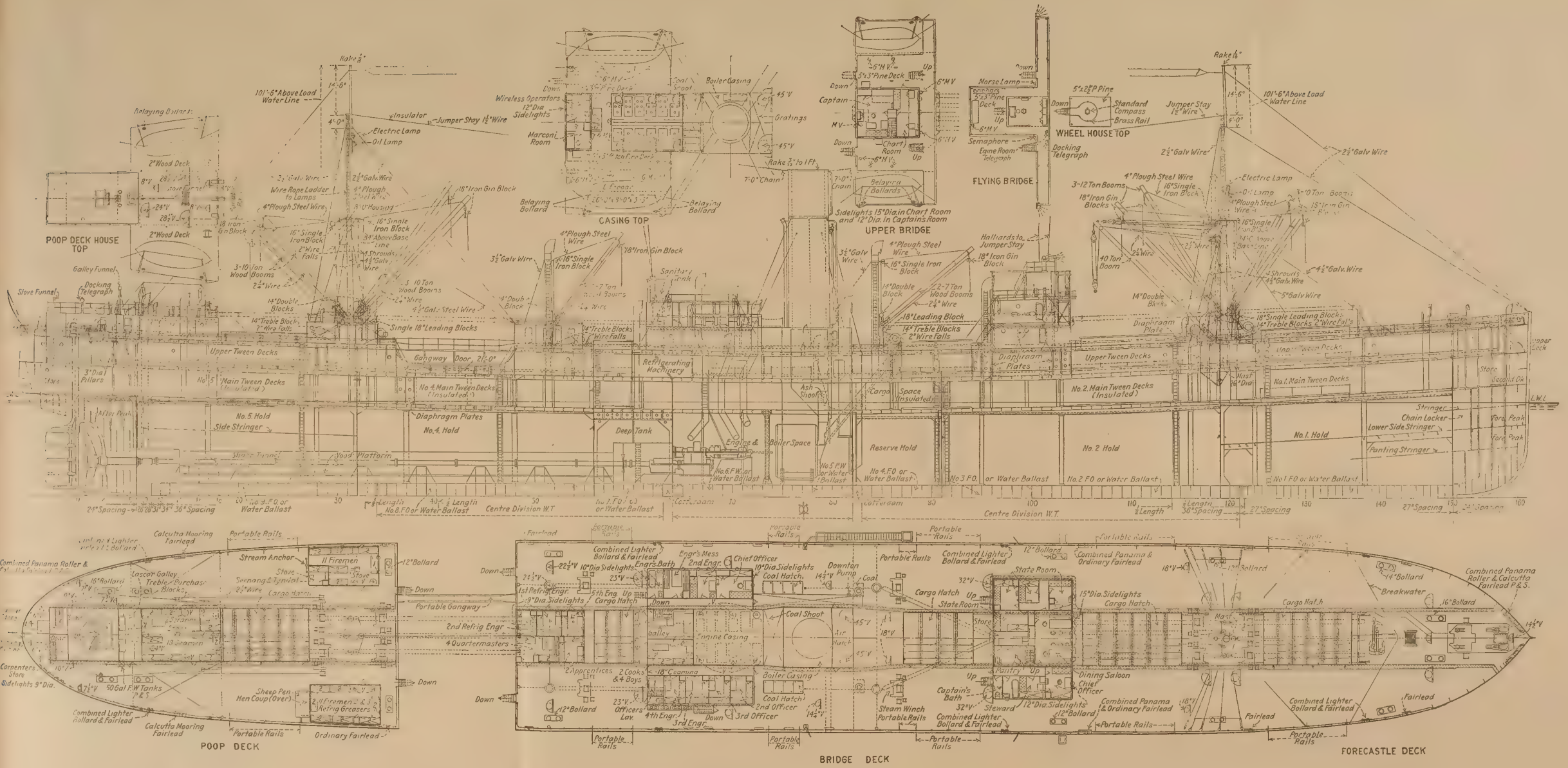
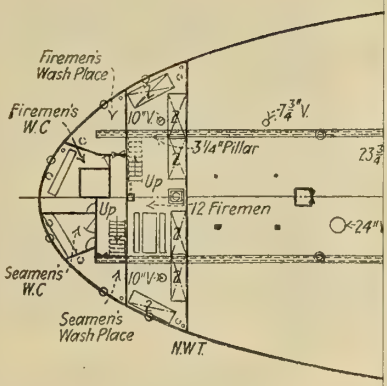
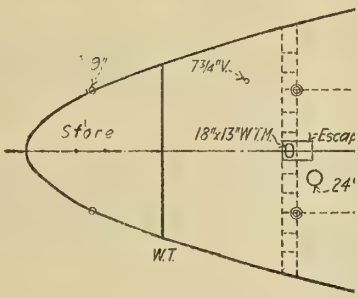
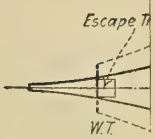


Fig. 1.—Profile and Weather Deck Plans


Firemen's Wash Place
Firemen's W.C
10"V
7¾"V.
3¼"Pillar
Up
Up
72 Firemen
24"
Seamen's W.C
10"V
Seamen's Wash Place
N.W.T.


9"
7¾"V.
Store
18"x13"W.T.M.
Escap
24"
W.T.


Escape T
W.T.

REFRIGERATOR AND CARGO STEAMER CITY OF PEKIN

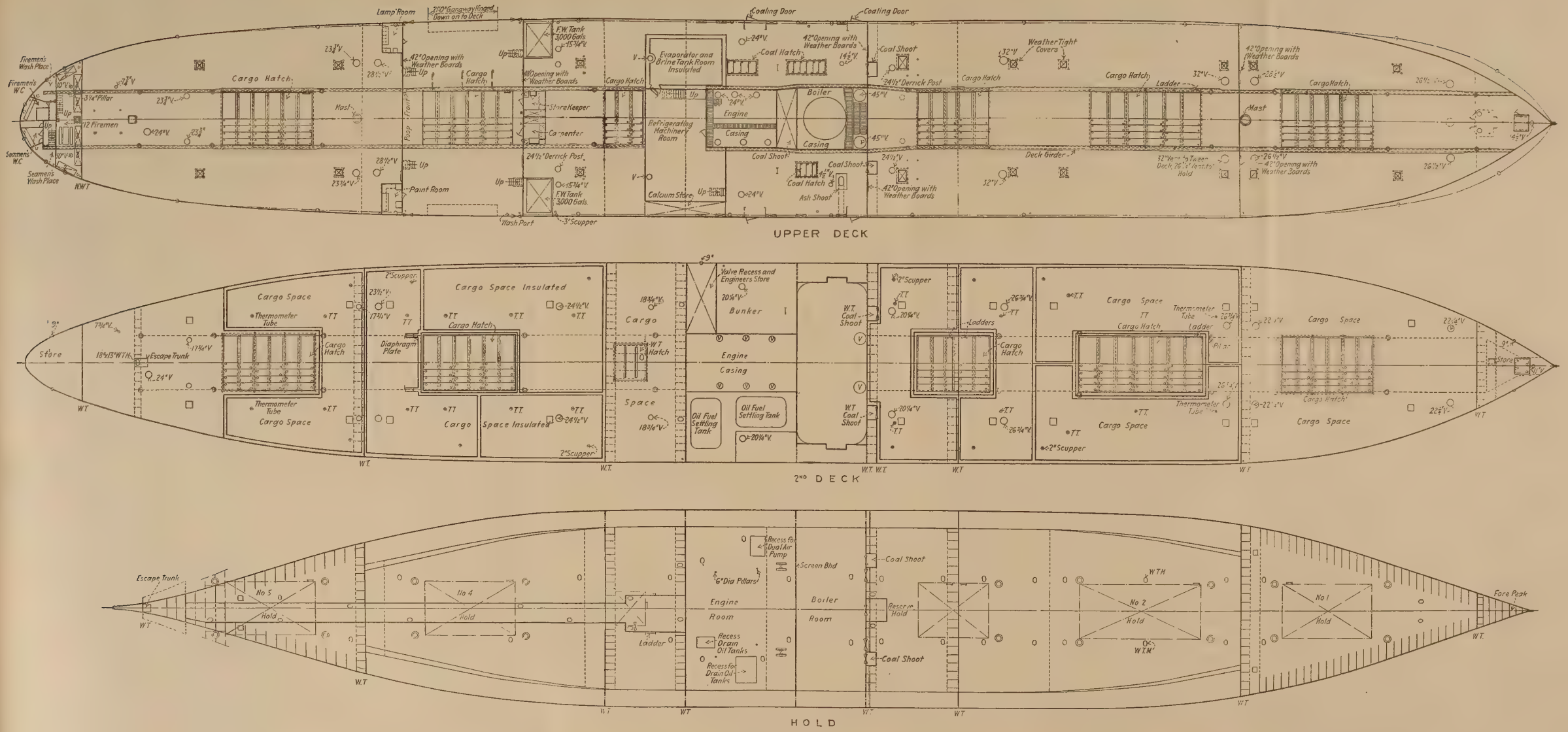
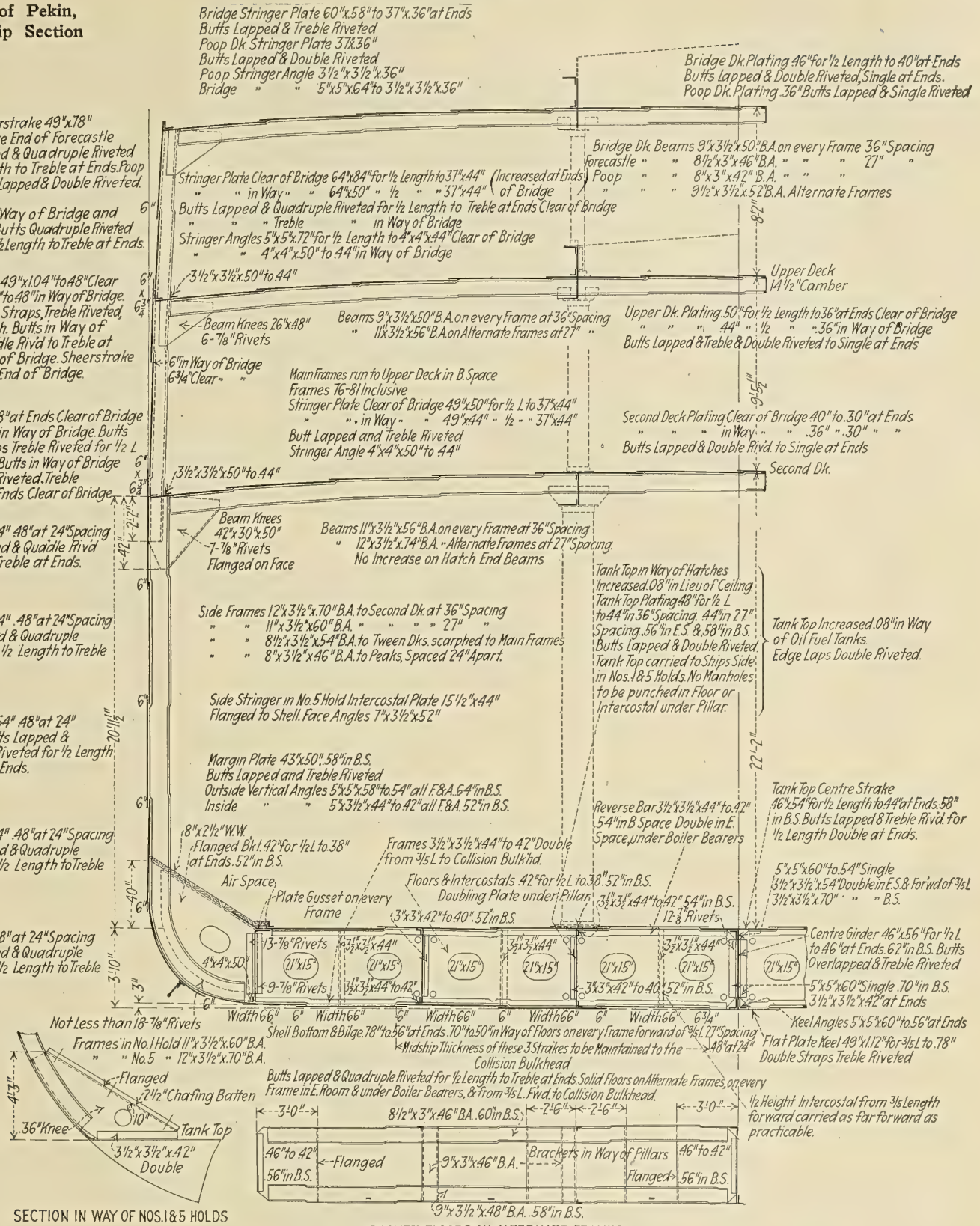


Fig. 2.—Deck Plans

City of Pekin, Midship Section


Bridge Stringer Plate 60"x.58" to 37"x.36" at Ends
Butts Lapped & Treble Riveted
Poop Dk. Stringer Plate 37"x.36"
Butts Lapped & Double Riveted
Poop Stringer Angle 3½"x3½"x.36"
Bridge " " 5"x5"x.64" to 3½"x3½"x.36"
Bridge Dk. Plating .46" for ½ Length to .40" at Ends
Butts Lapped & Double Riveted, Single at Ends.
Poop Dk. Plating .36" Butts Lapped & Single Riveted
Bridge Sheerstrake 49"x.78" to .42" at Fore End of Forecastle
Butts Lapped & Quadruple Riveted for ½ Length to Treble at Ends. Poop Side .40" Butts Lapped & Double Riveted.
.76" to .42" in Way of Bridge and Forecastle. Butts Quadruple Riveted Overlaps for ½ Length to Treble at Ends.
Bridge Dk. Beams 9"x3½"x.50" B.A. on every Frame 36" Spacing
Forecastle " " 8½"x3"x46" B.A. " " " 27" "
Poop " " 8"x3"x42" B.A. " " "
" " 9½"x3½"x.52" B.A. Alternate Frames
Stringer Plate Clear of Bridge 64"x.84" for ½ Length to 37"x.44" (Increased at Ends
" " in Way " " 64"x.50" " ½ " " 37"x.44" of Bridge
Butts Lapped & Quadruple Riveted for ½ Length to Treble at Ends Clear of Bridge
" " " Treble " in Way of Bridge
Stringer Angles 5"x5"x.72" for ½ Length to 4"x4"x.44" Clear of Bridge
" " 4"x4"x.50" to .44" in Way of Bridge
3½"x3½"x.50" to .44"
Upper Deck
14½" Camber
Sheerstrake 49"x1.04" to 48" Clear of Bridge. .76" to 48" in Way of Bridge. Butts Double Straps, Treble Riveted, for ½ Length. Butts in Way of Bridge, Quadle Rivd to Treble at Ends Clear of Bridge. Sheerstrake Doubled at End of Bridge.
Beam Knees 26"x48"
6-7/8" Rivets
Beams 9"x3½"x.50" B.A. on every Frame at 36" Spacing
" 11"x3½"x.56" B.A. on Alternate Frames at 27" "
Upper Dk. Plating .50" for ½ Length to 36" at Ends Clear of Bridge
" " " .44" " ½ " " .36" in Way of Bridge
Butts Lapped & Treble & Double Riveted to Single at Ends
6" in Way of Bridge
6¾" Clear " "
Main Frames run to Upper Deck in B. Space
Frames 76-81 Inclusive
Stringer Plate Clear of Bridge 49"x.50" for ½ L to 37"x.44"
" " in Way " " 49"x.44" " ½ " " 37"x.44"
Butt Lapped and Treble Riveted
Stringer Angle 4"x4"x.50" to .44"
72"x.90" to .48" at Ends Clear of Bridge
72"x.76"-.48" in Way of Bridge. Butts Double Straps Treble Riveted for ½ L Amidships. Butts in Way of Bridge Quadruple Riveted. Treble Riveted at Ends Clear of Bridge.
Second Deck Plating Clear of Bridge .40" to .30" at Ends
" " " in Way " " .36" " .30" " "
Butts Lapped & Double Rivd. to Single at Ends
3½"x3½"x.50" to .44"
Second Dk.
72"x.76" to .54" .48" at 24" Spacing
Butts Lapped & Quadruple Rivd for ½ L to Treble at Ends.
Beam Knees
42"x.30"x.50"
7-7/8" Rivets
Flanged on Face
Beams 11"x3½"x.56" B.A. on every Frame at 36" Spacing
" 12"x3½"x.74" B.A. " Alternate Frames at 27" Spacing.
No Increase on Hatch End Beams
Tank Top in Way of Hatches
Increased .08" in Lieu of Ceiling.
Tank Top Plating .48" for ½ L to 44" in B Space. Double in E. Space, under Boiler Bearers
72"x.76" to .54" .48" at 24" Spacing
Butts Lapped & Quadruple Riveted for ½ Length to Treble at Ends.
Side Frames 12"x3½"x.70" B.A. to Second Dk. at 36" Spacing
" " 11"x3½"x.60" B.A. " " " " 27" "
" " 8½"x3½"x.54" B.A. to Tween Dks. scarphed to Main Frames
" " 8"x3½"x.46" B.A. to Peaks, Spaced 24" Apart.
Tank Top Increased .08" in Way of Oil Fuel Tanks.
Edge Laps Double Riveted.
Side Stringer in No. 5 Hold Intercostal Plate 15½"x.44"
Flanged to Shell. Face Angles 7"x3½"x.52"
66"x.76" to .54" .48" at 24" Spacing. Butts Lapped & Quadruple Riveted for ½ Length to Treble at Ends.
Margin Plate 43"x.50" .58" in B.S.
Butts Lapped and Treble Riveted
Outside Vertical Angles 5"x5"x.58" to .54" all F.&A. .64" in B.S.
Inside " " 5"x3½"x.44" to .42" all F.&A. .52" in B.S.
Tank Top Centre Strake
46"x.54" for ½ Length to 44" at Ends. .58" in B.S. Butts Lapped & Treble Rivd for ½ Length Double at Ends.
Reverse Bar 3½"x3½"x.44" to .42"
.54" in B Space Double in E. Space, under Boiler Bearers
8"x2½" W.W.
Flanged Bkt .42" for ½ L to .38" at Ends. .52" in B.S.
Frames 3½"x3½"x.44" to .42" Double from ½ L to Collision Bulkhd.
66"x.76" to .54" .48" at 24" Spacing
Butts Lapped & Quadruple Riveted for ½ Length to Treble at Ends.
Air Space
Plate Gusset on every Frame
Floors & Intercostals .42" for ½ L to .38" .52" in B.S.
Doubling Plate under Pillar 3½"x3½"x.44" to .42" .54" in B.S.
12-8/8 Rivets
3"x3"x.42" to .40" .52" in B.S.
5"x5"x.60" to .54" Single
3½"x3½"x.54" Double in E.S. & Forwd of ½ L
3½"x3½"x.70" " " B.S.
.80" to .56" .48" at 24" Spacing
Butts Lapped & Quadruple Riveted for ½ Length to Treble at Ends.
3-7/8" Rivets
3½"x3½"x.44"
21"x15"
4"x4"x.50"
9-7/8" Rivets
3½"x3½"x.44" to .42"
3¾"x3¾"x.42" to .40" .52" in B.S.
Centre Girder 46"x.56" for ½ L to 46" at Ends. .62" in B.S. Butts Overlapped & Treble Riveted
5"x5"x.60" Single .70" in B.S.
3½"x3½"x.42" at Ends
Not Less than 18-7/8" Rivets
Width 66" 6" Width 66" 6" Width 66" 6" Width 66" 6" Width 66" 6¾"
Keel Angles 5"x5"x.60" to .56" at Ends
Shell Bottom & Bilge .78" to .56" at Ends. .70" to .50" in Way of Floors on every Frame forward of 3/5 L 27" Spacing
Midship Thickness of these 3 Strakes to be Maintained to the Collision Bulkhead
48" at 24"
Flat Plate Keel 49"x1.12" for 3/5 L to .78"
Double Straps Treble Riveted
Frames in No. 1 Hold 11"x3½"x.60" B.A.
" " No. 5 " 12"x3½"x.70" B.A.
Flanged
2½" Chafing Batten
10"
36" Knee
Tank Top
3½"x3½"x.42" Double
Butts Lapped & Quadruple Riveted for ½ Length to Treble at Ends. Solid Floors on Alternate Frames, on every Frame in E. Room & under Boiler Bearers, & from 3/5 L. Fwd. to Collision Bulkhead.
½ Height Intercostal from 3/5 Length forward carried as far forward as practicable.
3'-0"
8½"x3"x.46" B.A. .60" in B.S.
2'-6"
2'-6"
3'-0"
.46" to .42" .56" in B.S.
Flanged
9"x3"x.46" B.A.
Brackets in Way of Pillars
.46" to .42" Flanged .56" in B.S.
9"x3½"x.48" B.A. .58" in B.S.

SECTION IN WAY OF NOS. 1 & 5 HOLDS

BRACKET FLOORS ON ALTERNATE FRAMES

Forgings

Stem bar.....11 inches by 2⅞ inches.
Stern frame.....R. P. 9½ inches by 8½ inches, P. P. 11 inches by 8½ inches.
Rudder as per rule 11½ inches + owners reg. = 12 inches.

Additional Scantlings (required by owners).

.02 on the bridge deck plating.
.04 on the bridge deck sheerstrake.
.04 on the bridge side plating.
.02 on the upper deck plating for full length.
.02 on the second deck plating for full length.
.02 on the upper deck stringer for ½ length amidships.
.02 on the second deck sheerstrake for ½ length amidships.
.04 on the upper deck steerstrake in way of erection.
.10 on all the floors and intercostals and tank top under the boilers.
.02 on the engine room and stokehold bulkheads and these bulkheads heavily bracketed to the decks.
Sheerstake increased 50 percent right through well aft.

The following strengthening to be added to the vessel for Atlantic work:
.04 on shell plating from keel to 1 foot 6 inches above top stringer and from frame 129 to stem.
Deep knees to lower tier of beams in fore peak.
No reduction in main frames in No. 1 hold.
Frames in fore peak increased .04 inch in thickness.
Floors increased in depth in fore peak.
Frame bottoms doubled from frame 122 to collision bulkhead.
Stringer increased 1 inch from frame 119 to collision bulkhead.

Fig. 3.—S. S. City of Pekin, Midship Section

City of Pekin Machinery Arrangement, Plans and Elevation

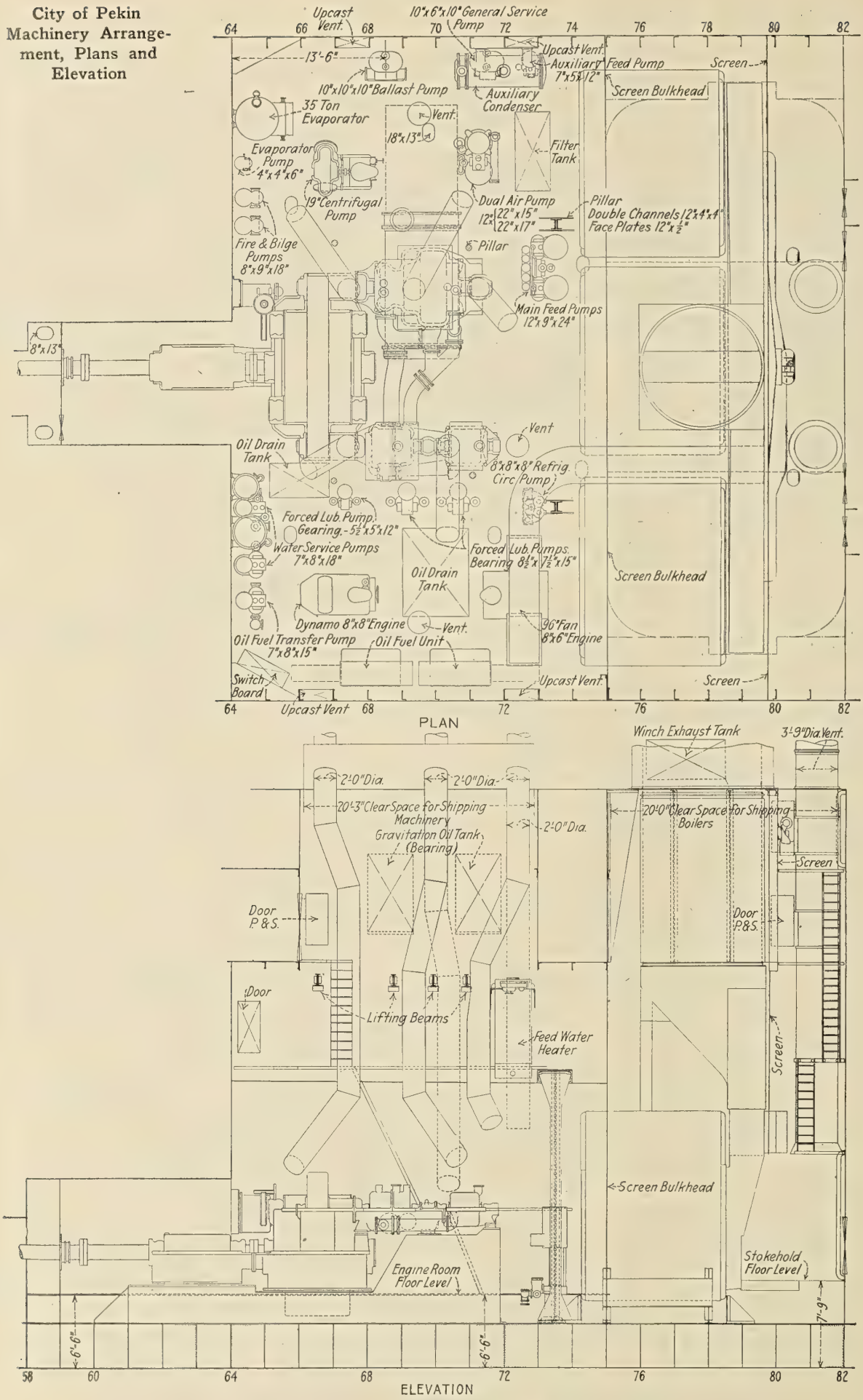
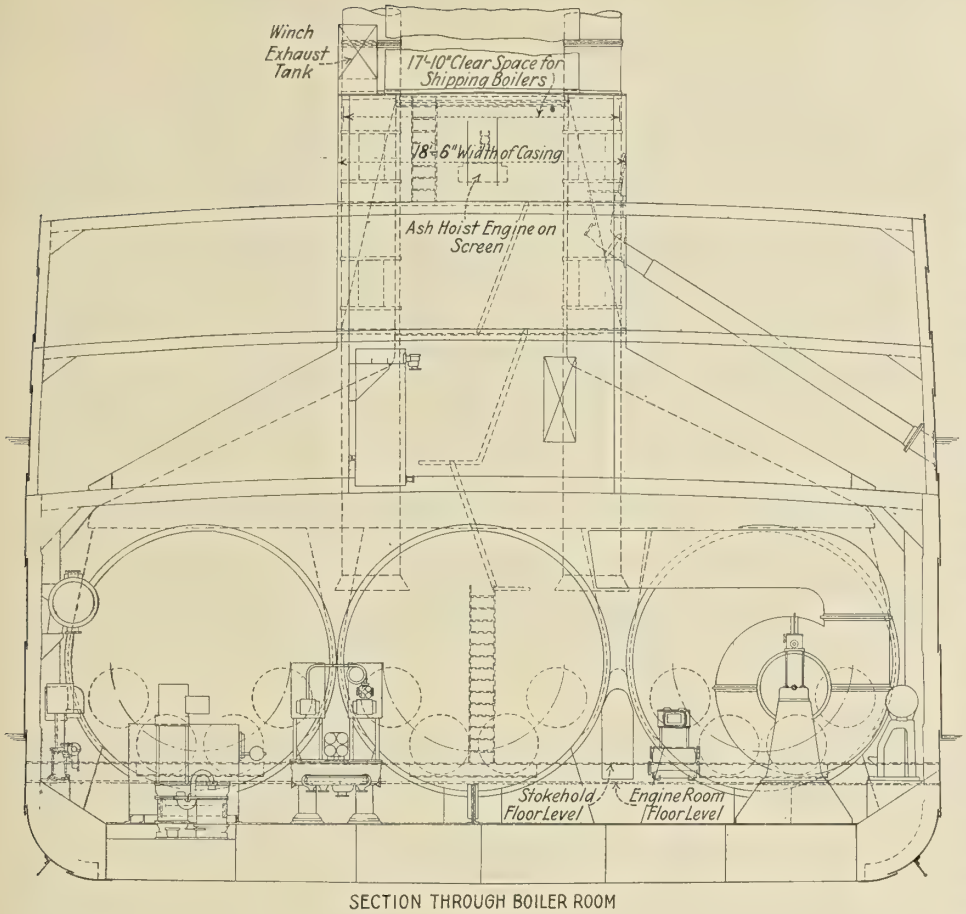
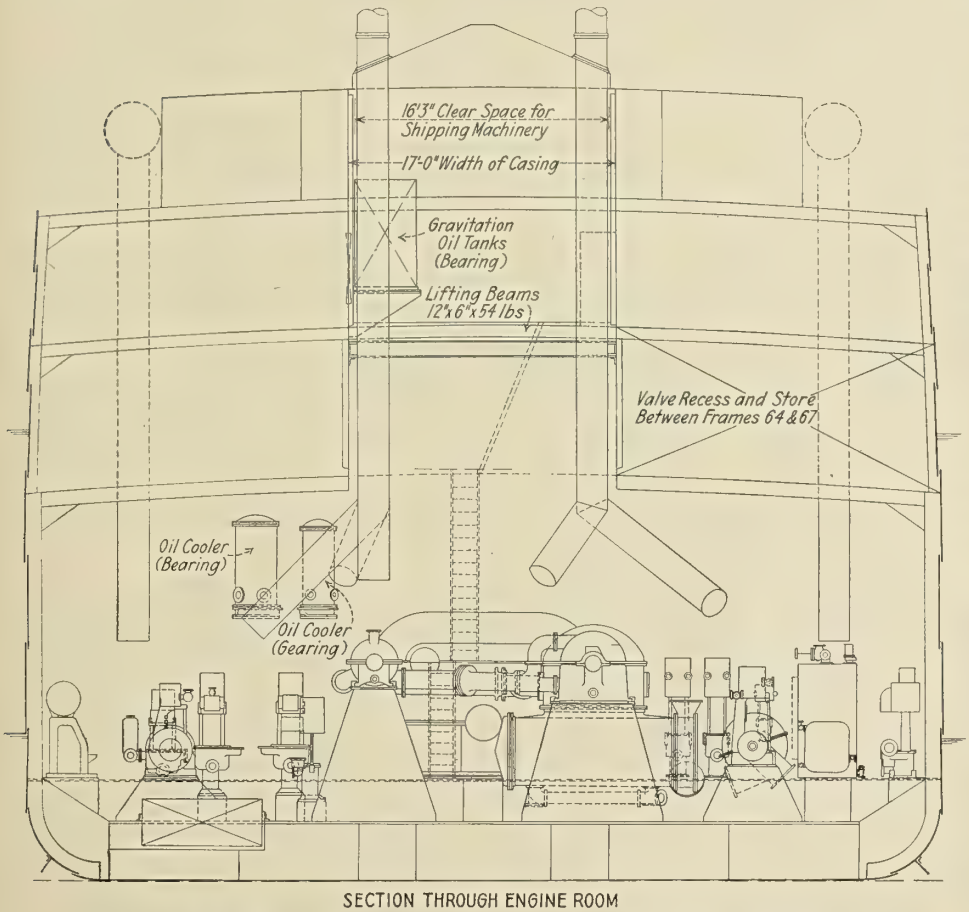


Fig. 4.—S. S. City of Pekin: Plan and Elevation of Engine and Boiler Rooms


Winch Exhaust Tank
17'-10" Clear Space for Shipping Boilers
18'-6" Width of Casing
Ash Hoist Engine on Screen
Stokehold Floor Level
Engine Room Floor Level

SECTION THROUGH BOILER ROOM


16'3" Clear Space for Shipping Machinery
17'-0" Width of Casing
Gravitation Oil Tanks (Bearing)
Lifting Beams 12"x6"x54 lbs.
Valve Recess and Store Between Frames 64 & 67
Oil Cooler (Bearing)
Oil Cooler (Gearing)

SECTION THROUGH ENGINE ROOM

Fig. 5.—S. S. City of Pekin: Sections Through Boiler and Engine Rooms

Naval Architects' Annual Meeting

THE twenty-ninth general meeting of the Society of Naval Architects and Marine Engineers will be held in Assembly Room No. 1 of the Engineering Societies Building, 29 West 39th street, New York, on Thursday and Friday, November 17 and 18, 1921. The annual banquet will be held in the Grand Ball Room, Waldorf-Astoria Hotel, New York, on Friday evening, November 18.

During the meeting the second session on Thursday, November 17, from 2 to 5 P. M., will be set aside for the purpose of holding a joint meeting with the American Institute of Electrical Engineers at which two papers will be presented, one devoted to electrical propulsion and the other to electrical auxiliaries.

During the week of November 14, coincident with the meeting of the Naval Architects' Society, the first annual exhibit of the Marine Equipment Association will be held in the Central Mercantile Building, Sixth avenue, 18th to 19th streets, New York city, and it is the intention to reserve certain hours each day for members of the society and others intimately interested in the exhibits to attend the exposition.

COMPUTERS WANTED. — The United States Civil Service Commission announces an open competitive examination for computer on September 21 to 22 and November 2 to 3, 1921. Vacancies in the Coast and Geodetic Survey for duty in Washington, D. C., at $1,400 a year and for duty in the Manila, P. I., office at $2,000 a year, and vacancies in positions requiring similar qualifications at these or higher or lower salaries will be filled from this examination unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion.

CORRECTION.—In the article entitled "Are You a Marine Engineer, Edison Standard," published on page 588 of the August issue, question No. 65 should have read "Why Should Not Alternating Current Be Used for the Lighting Set on an Electrically Driven Ship?"

COMMANDER V. V. WOODWARD, U. S. N., has resigned as manager of the repair department of the United States Shipping Board and will return to active service in the United States Navy.

The Americanization of Our Merchant Marine

By "Old Scotch"

Louis the Sixteenth of France depended upon his Swiss Guards to protect him. We all know that Louis eventually had his head chopped off. Great Britain depended largely upon her Hessian hirelings to subjugate her colonies during our War of the Revolution. We know what happened to the Hessians. Both of these matters of history tend to prove that when you have a national job to attend to you ought to employ your own people, if you want it done right.

SHIPPING on the seven seas is just as much a national job as fighting, hence if we are going to depend on hirelings from other nations to run our merchant marine we will get what happened to King Louis and King George, not to mention numerous other potentates in the world's history, who placed too much dependence on foreign help. And we will deserve it.

In our merchant marine development we have reached a point where there must be a "show down" to use a popular phrase familiar, I feel sure, to some of our readers. Up to this time we have operated our ships like a meeting of the League of Nations. Most of them, it is true, have had American captains and chief engineers, but the remainder of the officers and the crews have been drawn from the "57 varieties" of seafaring men which inhabit the world at large. They have been attracted to our ships by the best wages and best grub found anywhere afloat. I don't blame them for coming and I have no criticism to make of them, except for the fact that they have not appreciated what easy berths they have had.

Alien Crews Must Go

The time has now arrived for them to go home, except those few who are sincerely anxious to become American citizens and adopt our flag as their own and who have not only declared their intention by taking our their first papers but who by their actions and habits have demonstrated that they can and will become desirable additions to our population. All "red ink" men and other seafarers, who are at heart merely professing Americanism for revenue only, had better take their hats and go, as from now on we will have enough genuine Americans to man all our own ships.

Just at present there are not many operating ships to man, hence the greater reason for giving our own seafaring men all the ship jobs we have, as there are today hundreds and even thousands of good, competent Americans walking the streets of our seaports, while many of our ships are sailing with aliens in their crews.

Competent American Crews Are Available

The new Shipping Board has thus far functioned most acceptably. Their appointments have been fine and their actions have rung with the right tone. To a man they seem imbued with the American spirit of making our shipping efforts a success. The time is now most propitious, when there are so few ships operating and so many men looking for jobs, to come out with a cast iron resolution that from now on every man from the captain down to the lowest ratings among the seamen and firemen must be American citizens on every ship owned wholly, or in part, by the United States Government. The private shipowners can be depended upon to follow suit, as it will be demonstrated that American ships operated entirely by American citizens will be much more profitable than the same ships manned by crews who have no interest in their jobs other than to get all out of them they can for their personal gain in wages and comfort.

It is nonsense to say that there are not enough Americans to man all our ships, both of public and private ownership. There are probably two hundred thousand young Americans today who were trained at sea during the war both on naval and merchant vessels. Over one hundred and fifty thousand men have been discharged from our shipyards during the last year. At least one-third of these men could fill jobs aboard ship very acceptably, especially in the engine room force. With the tonnage we are now operating, it is probable that not over fifty thousand officers and men are necessary for the entire fleet. Therefore at this time we not only can have enough Americans for every job at sea, but our shipping directors can pick and choose and secure only the most competent for the available billets.

A Sample of Present Conditions

To best illustrate the way some of our ships are being run right now, I have only to quote from a letter received today from a young third mate on an American owned and American built steamer of 12,000 tons deadweight.

* * * "Here are just a few things, 'Packet.' To begin with the wireless operator and myself are the only Americans (real ones) on the d——n ship. The captain may be, but he doesn't act like one. The chief engineer is Irish, the first assistant engineer a German, the second assistant engineer is Danish. The chief officer is Danish, the second officer is Norwegian and the third officer, your humble servant, a genuine American. In the fireroom of course only Spaniards, Greeks and Italians. The whole steward's department is half white mongrel West Indians, the worst in the world. The whole deck crew are a mixed lot, with even two darkeys for sailors. Already the first assistant engineer (German) has had a fist fight with the second assistant (English). The Danish chief officer has no use for the second officer (Norwegian), etc., and thus it goes."

What a commentary on the American merchant marine! And this ship belongs to an old-established American shipping firm at that. How can we expect to run ships with a bunch of marine highbinders such as this young man has described? What a degrading influence for young American officers and seamen to be thrown into contact with such disturbing elements! It is time to call a halt on all such floating congresses of nations as this one, sailing around under the American flag. If we cannot get American citizens to officer and man our ships, let's quit the seas and acknowledge to the world our incompetency!

But it can be done, as I have already pointed out. The men are available and willing and we have the ships to man. All it needs is a determined effort on the part of the Shipping Board and I, for one, feel confident that the present membership has the nerve and resolution to put a stop to this alien domination of our merchant ships.

The Source of Trouble

It's a safe bet that nine-tenths of all the strikes, Bolshevistic uprisings, near mutinies, yes, and sabotage, with which our American operated ships have been cursed within the past three or four years, are directly due to the bunch of marine nondescripts of all nations which have been hired as crews. Much of it is traceable to the internationalism of certain unions, in which Americans have no control. It is

very refreshing to learn that a real American seamen's union has recently been formed and it is hoped that both the Government and the private shipowners will do their best to encourage such an organization.

One Hundred Percent American Shipping

No ship, hereafter, which belongs to the United States Government should be allowed to sail unless she has a 100 percent crew of American citizens. In every chartered ship controlled by the Shipping Board a clause should be put in the charter requiring the operator to employ none but citizens of the United States, or those who have declared their intentions of becoming citizens and who, by their demeanor, prove that they expect to live up to their intentions and will make worthy citizens.

We should go further than having the ships manned by Americans and require that every representative of the Shipping Board abroad, and at home, too, for that matter, should be a citizen both legally and in spirit. Secretary Hoover, of the Department of Commerce, recently said, in a public address, that we will never extend our foreign commerce unless we have our own nationals to transact our business abroad. Every other nation which has obtained any success in foreign commerce has built up its trade by having its own citizens at every point to transact its business.

Shall we be guided by the lessons of history and by the examples of successful competitors? Or shall we stumble along in this blind and irrational way we are now operating our ships? Gentlemen of the Shipping Board, it is up to you to take the initiative in this most vital matter of Americanizing our merchant marine and to do it quickly. Make our merchant marine one hundred percent American!

Encouragement of American Marine Insurance

Chief of New Governmental Activities That Have Contact with Shipping and Shipbuilding

By Waldon Fawcett

WITH the reorganized Shipping Board given a free hand to work out its own salvation, the Congress of the United States is turning to some of the more important problems, incident to the upbuilding of an American merchant marine that were left for future consideration when the Merchant Marine Act of 1920 was enacted. It is surprising how many supplementary issues thus await attention, ranging all the way from the load line proposition to the project to allow passage through the Panama Canal, without payment of tolls, of American vessels engaged in the coastwise trade.

Perhaps the most important, however, of all waiting responsibilities is that which involves encouragement for the development in the United States of resources adequate to provide marine insurance for the American fleet. This is a need which has been recognized since the inception of the program which resulted in enactment of the Merchant Marine Act. The first thought was to provide in that general bill for the necessities in insurance facilities upon which in a measure will wait the progress of the American merchant marine. Upon investigation it was disclosed, however, that the remedy for the shortcomings of marine insurance facilities in this country must be found not in national legislation but in legislation by the various States of the Union, with the object of rendering uniformly favorable the conditions under which marine underwriting may be carried on.

Model Insurance Bill

With the recognition that it rests with the States to encourage support for marine insurance, there has been realization on the part of the friends of the merchant marine that it would speed the movement, if there were some way in which Congress could take the initiative. Out of this desire to have the national legislature point the way has grown the legislative measure that is now pending in both Senate and House of Representatives, having been favorably reported during the past month. This takes the form of a bill to regulate marine insurance in the District of Columbia. In the District of Columbia, Congress exercises the functions of a State legislature. Hence the proposal for the enactment for this jurisdiction of a marine insurance act, which should serve as a model statute for all the States and an object lesson in effective procedure.

The marine insurance bill (designated officially S. 2265 or H. R. 6775) was introduced in the House of Representatives in June and in the Senate in July, being promptly reported favorably, with recommendation for passage, by the respective committees to which it was referred. In reporting the bill to the Senate, the latter part of July, Senator Jones, as chairman of the Committee on Commerce, remarked that it will probably be necessary to use "heroic" measures to build up an American merchant marine. One of the most important factors, he believes, in the maintenance of a merchant marine and the development of foreign commerce is marine insurance.

Insurance a Big Factor

It was his observation that the nation whose citizens control marine insurance largely controls the world's marine and trade. This he attributed to the circumstance that the men and companies who do marine insurance learn the business methods and trade secrets of marine and commercial competitors and they do this without disclosing anything of the practices or secrets of their own allied marine and commercial interests. Emphasis was laid on the fact that more than two-thirds of the insurance on American ships and cargoes is done by foreigners. More than three-fourths of American hull insurance is done by foreigners. This should not be, declared Senator Jones, especially now when the United States has so large a tonnage that it hopes to have operated profitably in the foreign trade.

In urging upon his fellow legislators the enactment without delay of the pending measure, the chairman of the Senate Committee on Commerce declared that one of the great handicaps to the growth of American marine insurance is the diversity of American laws affecting it. Legislative jurisdiction over this subject rests with the various States and there is no uniformity in their legislation. Little account seems to have been taken by the respective States of the broad interests of the nation. Not only have no efforts been made to aid in building up marine insurance but many States have provisions of law that are actual handicaps to such development.

Nation's Interest Shown

The deliberately considered and carefully drafted marine insurance bill which Congress is expected to make effective

in the District of Columbia is an attempt to show the nation's interest in this subject and to suggest model legislation, which it is hoped will be followed by the various States. The prospective statute takes a nation's view of the marine insurance problem, but always with due regard for local interests. It is an expression by the general government of what is needed to serve a national purpose, and it only remains for the various States to follow it as closely as may be in order to lay the foundation for an adequate marine insurance structure. While marine insurance companies will doubtless be organized forthwith in the District of Columbia in order to take advantage of the opportunities offered, the arrival of the millennium in American marine insurance conditions must, perforce, wait upon the enactment of sympathetic legislation in the various States of the Union.

This formal solution for the marine insurance problem, which now awaits the O. K. of Congress, is the product of a special investigation by Congressional committees which has extended over a period of two years. Incident to this survey experts were employed to study the question in all its aspects. Summarizing the result of such research, Dr. S. S. Huebner, the insurance expert, recently reported to Congress that about one-half of all the reinsurance placed by American companies is placed with foreign underwriters. A great majority of the American underwriters informed the investigators that this was not due to choice but to necessity. Facilities have been so limited that an American company which could only accept a reasonable amount of insurance on a particular risk has been obliged to resort to the foreign markets in order to place the insurance offered to it.

Insurance Exported Directly to Foreign Markets

Stressing the moral, already pointed, the investigation also developed the fact that a very large proportion of the marine insurance originating in the United States has been exported directly to the foreign markets. That is to say it was placed with alien underwriters who did not even have a branch office in this country—were not "admitted companies." Dr. Huebner remarked that it was hard to say just how much insurance is exported in this way, but, through correspondence, he developed the fact that as regards 67 non-admitted alien underwriters this country sent out $12,000,000 in premiums for the year 1918. This excluded all the insurance placed with Lloyd's and many other sources which the experts did not discover. All told, two-thirds of all American marine insurance originating in this country was found to be under foreign control during the period covered by the Congressional investigation. A circumstance not to be overlooked in this same connection is that exported insurance pays no taxes whatever to this country.

Menace to Commercial Secrets

Louder even than the alarm in the Senate is that which has been sounded in the House of Representatives. In reporting the marine insurance bill, Congressman Focht of the Committee on the District of Columbia proclaimed the danger of allowing marine insurance originating in the United States to be under foreign domination. In his belief no other strategic branch of American commerce has been handed over so completely to the control of foreign interests. He also took cognizance of the fact that the bulk of the business transacted by American companies has been written by a very few. Two companies received nearly one-fourth of the total net marine premium income and ten companies received approximately two-thirds of such income. While American companies placed one-half of their reinsurance with foreign underwriters, the reinsurance placed by foreign underwriters with American companies was only about one-half the reinsurance that went from the United States to interests overseas. Moreover, American companies have never been able thus far to enter the foreign field to any appreciable extent, and in many important commercial countries not a single branch of an American insurance company may be found.

In declaring the need for an ample and independent American marine insurance institution, the summons to action, that has recently been served on the House of Representatives, declares that nations that are strong in marine-insurance facilities may deny the service altogether or give it only under unfavorable conditions to the citizens of other nations which do not possess adequate facilities of their own. The menace to commercial secrets is proclaimed just as it has been by the Commerce Committee of the Senate. It is pointed out that foreign underwriters, when insuring American cargoes, necessarily learn the facts concerning the carriers used, the consignees, methods of packing and handling, financial affiliations of the consignors, costs of production and the conditions and price of sales.

The current effort to bring about, State by State, removal of the legislative obstacles which unnecessarily restrict the underwriting activities of American companies constitutes but half of a two-part program for fostering American marine insurance. Quite as serious as the State laws, which operate to make it impossible for American underwriters to meet foreign rates, has been the failure, in the past, of American companies to cooperate in the interest of economy and efficiency, as have their foreign competitors. It is difficult to say which of these two elements constitutes the most formidable factor.

American Marine Insurance Syndicates

Lack of cooperation or team play in marine insurance activities is, however, in a fair way to removal, thanks to Congress and the Shipping Board, through the creation of the American Marine Insurance Syndicates, known as Syndicates A, B and C. Syndicate A is a purely service syndicate and represents a salvage association which will work hand in hand for the development of the market through the medium of the two underwriting syndicates (Syndicates B and C) and will be to the American shipping trade and to the American marine insurance market what the London Salvage Association is to the British shipping trade and the British marine insurance market. All of the syndicates are now fully organized and functioning and are enlarging the scope of their usefulness.

Through these syndicates, as their work has lately been pictured to Congress, a total of $2,500,000 may be bound promptly through a central office on a single vessel, each of the fifty member companies taking its alloted share of the total risk. Instead of the broker having to interview some fifty underwriting offices, as in the past, his work is now concentrated at one office at a big saving of time and expense. One policy takes the place of fifty or one hundred policies on a single risk. In the same way, losses are settled through a central office by one check instead of the previous method of applying to each company for its share of the claim. Adjustment of losses will also be handled jointly at a great saving in time and expense instead of having numerous companies represented by their individual adjusters.

Making Common Cause

Far from constituting a radical innovation, this new plan of cooperation simply represents the application to American marine insurance of principles which foreign competitors have followed advantageously for many years. It is by just such methods of cooperation that British companies have not only enlarged their underwriting capacity and strengthened their financial standing but have greatly reduced their overhead charges. By making common cause they have been enabled to give adequate service, to eliminate irritating jealousies, and to act, whenever an international competitive situation presents itself, as one united force capable of pursuing an intelligent policy. Syndicate arrangements, as lately

perfected in the United States, assure greater convenience and speed in the handling of large lines of insurance and facilitate the spread of large risks, thus fulfilling the function of automatic reinsurance.

With cooperative effort through syndicate arrangements an assured success, Congress and the country will be found ready, it is believed, to concentrate on the other half of the problem—elimination of legislative restrictions. The glaring deficiencies of present State statutes arise from the fact that these are provincial in character and in nearly all instances were designed with special reference to fire insurance, without recognition of the vital differences between fire and marine insurance. The hampering State laws are not adapted to the regulation of a business which vitally affects the commerce of the nation and which, unlike fire insurance, is essentially international in character and subject at all times to the keenest foreign competition. But by reason of decisions of the United States Supreme Courts which confirm the several States in complete supervisory control over insurance, no other method of procedure is possible than that whereby Congress undertakes to give a cue to the States, via a Congressional expression, on what is really a national measure.

Steam Trawler Rudyard Kipling

Some idea of the importance of the fishing industry to the United States may be gained by the following information. There are in the neighborhood of 200,000 *persons and* 7,500 *vessels engaged in our fisheries. The capital invested amounts to* $175,000,000 *and the annual production of fishery products is approximately two and a half billion pounds, valued at about* $85,000,000 *to the fishermen. Among the more important class of fishing vessels, both in England and America, is the steam trawler and a modern type of English practice is presented in the "Rudyard Kipling."*

THE *Rudyard Kipling*, recently constructed in the yard of Messrs. Cochrane & Sons, Ltd., Selby, Yorkshire, England, was built to the account of the Newington Steam Trawler Company, Ltd., of Hull, England. She is a first-class steam trawler designed for service in the waters about Iceland and is classed 100 A-1 by Lloyd's for fishing purposes. The principal dimensions of the vessel are as follows:

Length	138 feet 4 inches
Breadth, extreme	23 feet 9 inches
Depth, molded	13 feet 6 inches
Speed	11 knots

HULL

The hull is arranged with holds in which the fish may be stowed and is also fitted with stowage places or ponds on deck. The vessel's main and spare fish rooms, comprising the holds forward, are insulated on the sides and after bulkhead with Mackays Noel insulation.

A powerful steam winch is located amidships and a steam windlass forward.

Accommodations for the crew are provided forward; the officers are berthed aft.

MACHINERY

The main propelling machinery consists of one triple expansion engine having cylinders 13 inches, 23 inches and 37 inches in diameter by 26 inches stroke. The high pressure and intermediate pressure valves are of the piston type, the low pressure valve being of the "D" type.

The condenser, which is a separate casting, is carried by brackets on engine columns.

BOILERS

One large cylindrical boiler is fitted, having an internal diameter of 14 feet and a length of 10 feet 8 inches. It is designed to work under a pressure of 200 pounds per square inch. Three plain furnaces of the Gourley withdrawable type are provided.

The vessel is fitted throughout with electric light.

The *Rudyard Kipling* will be commanded by Skipper William Addy, formerly of the trawler *Conan Doyle*.

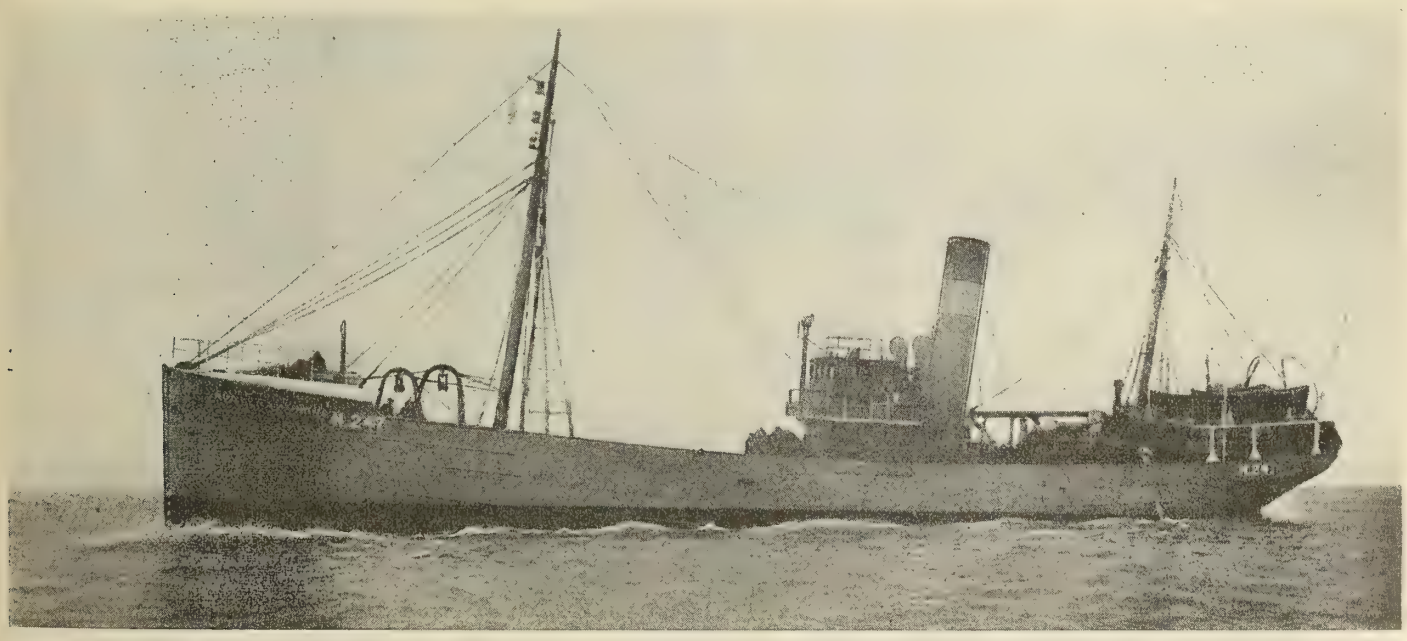


Fig. 1.—Steam Trawler Rudyard Kipling, Built by Messrs. Cochrane & Sons, for Newington Steam Trawler Company

Steam Trawler Rudyard Kipling

General Information

Service: Icelandic fishing.
Builder: Messrs. Cochrane & Sons, Ltd., Selby, Yorkshire, England.
Engines and Boiler: Messrs. Chas. D. Holmes & Co., Ltd., Hull, England
Owner: Newington Steam Trawling Co., Ltd., Hull, England.

Characterisics

Length, overall .....148'-0"
Length, B. P. .....138'-4"
Breadth, extreme .....23'-9"
Depth, molded .....13'-6"
Draft, loaded .....
Draft, light .....
Block coefficient .....
Midship section coefficient.....
Longitudinal coefficient .....
Speed, loaded, knots.....11
Cruising radius, nautical miles.....
Framing .....Transverse
Class..Lloyd's 100 A-1 for Fishing Purposes

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull.....
**Weight Propelling Machinery.....
Deadweight Capacity .....
Displacement .....

(In tons of 100 cubic feet)

Gross register 333
Net register 140

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.
**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez		
Panama		

Equipment

(1) Bower Anchor, stockless.....8 cwts.
(1) Bower Anchor, stockless.....7¼ cwts.
(1) Kedge Anchor, ex-stock.....3¼ cwts.
Cable, 1 2/16" stud link.....120 Fms.
Hawser, 6".....60 Fms.
Warp, 5".....60 Fms.

Rudder

Area .....
Dia. Stock .....
C. Press. abaft C. L. pintles.....

Complement

Deck officers .....
Deck crew .....
Engineer officers .....
Engineer crew .....
Purser's and steward's department.....
Total officers and crew.....17
First-class passengers .....
Second-class passengers .....
Third-class passengers .....
Total passengers .....
Total complement .....

Handling Equipment

	No.	Type	Capacity	Length
Masts	2	Pole	....	....
Booms	1	....	....	....
Discharging Capacity				

Deck Machinery

Steering Gear .....Hand
Windlass .....Steam
Capstans .....
Winches, trawl (1) steam with 2 barrels with a capacity of 1,000 fms. trawl rope each.
Winches, warping, (1) hand.

Life Saving Equipment

	No.	Type	Length
Lifeboats	2		17'-0"

Propelling Machinery

Boilers

Number 1
Type.....Single Ended Scotch
Length .....10'-6"
Diameter .....14'-0"
Furnaces 3
Fuel .....Coal
Draft .....Natural
Total heating surface, square feet....1,400
Total grate surface, square feet.....48
Superheat, degrees F.....
Working pressure, lbs. per sq. in.....200
Normal fuel consumption:
Per day, tons.....
Per housepower, pounds.....
Normal steam production:
Per hour per pound of fuel.....lbs.
Total per hour.....lbs.

Engines

Number 1
Type .....Triple expansion reciprocating
Size .....13"x23"x37"x26" stroke
Horespower 600

Propellers

Number 1
Type .....Four bladed
Weight .....
Diameter .....
Pitch .....
R. P. M. 113
Projected area.....
Developed area.....

Auxiliary Machinery

Machinery Space

Condenser, separate casting carried on brackets on engine columns.
Evaporators .....
Distillers .....
Filters .....
Feed water heater.....
Fuel oil heaters.. .....

Pumps:

Air .....
Feed .....
Bilge .....
} Driven by levers off the high pressure engine.

Circulating—Centrifugal type.
Boiler Feed—(1) 6x4½x6 vert. duplex.

Refrigerating Machinery

Electric Equipment

Generators—Electric lighting unit—4 pole compound wound dynamo, direct driven—60 lamps..
Radio .....
Emergency .....

Holds

No.	Length	Hatches
Fish hold	36'-8"	(4) 3'-4"x3'-4"

Capacities

Cargo Space

Compartment	Cu. Ft.
Fish hold	8,500

Refrigerated Space

Compartment	Cu. Ft.

Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons
Cross Bunker			146
Side Bunker (P).....			16
Side Bunker (S).....			13
Reserve Bunker			78
Total			253

*....cu. ft. per ton;.....gals. per bbl.

Tanks

Compartment	Cu. Ft.	Tons F. W.	Tons S. W.
F. W. Tank, For'd.....		5.37	
F. W. Tank, Aft.....		1.79	
Total		7.16	

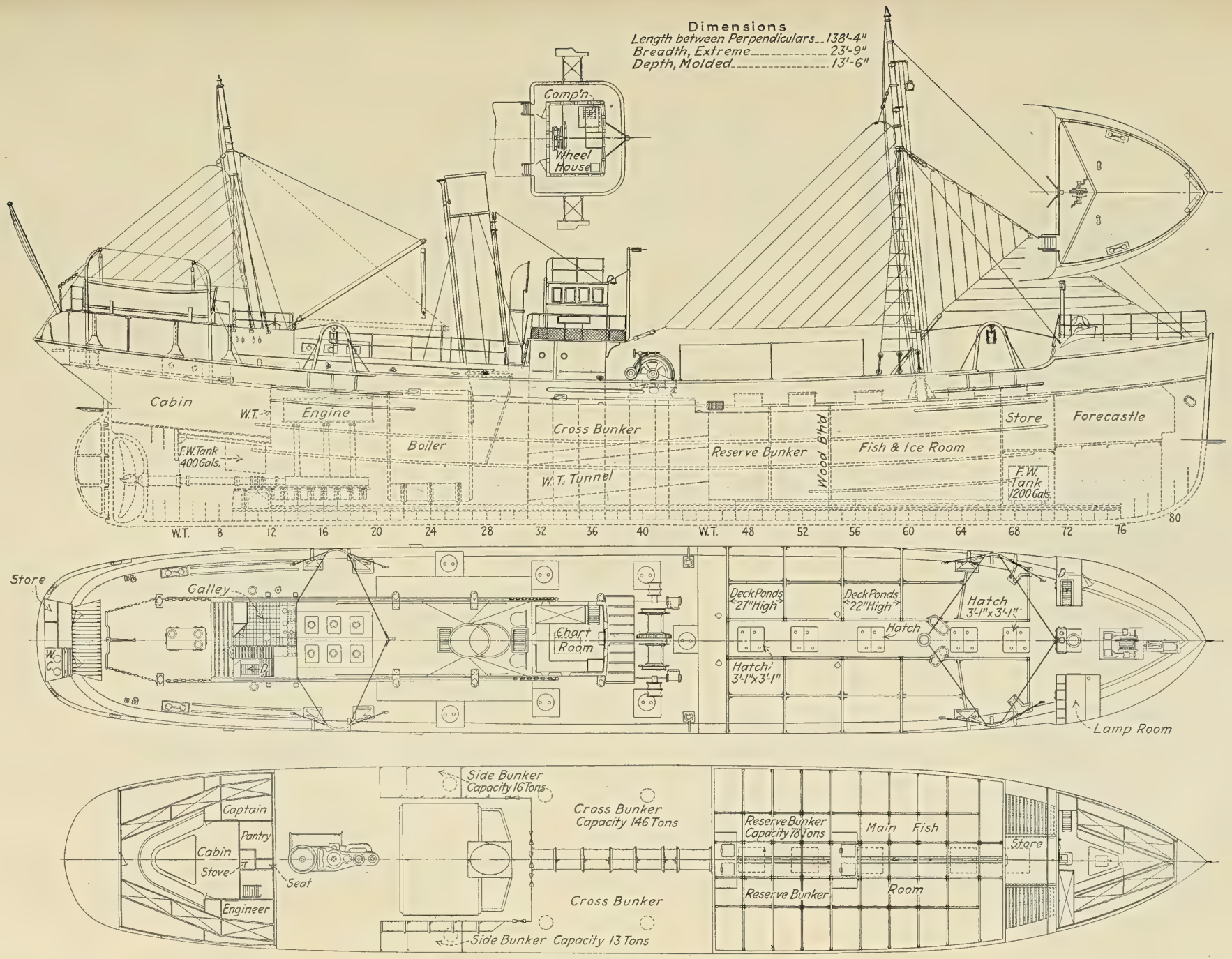


Fig. 2.—General Arrangement, S. S. Rudyard Kipling

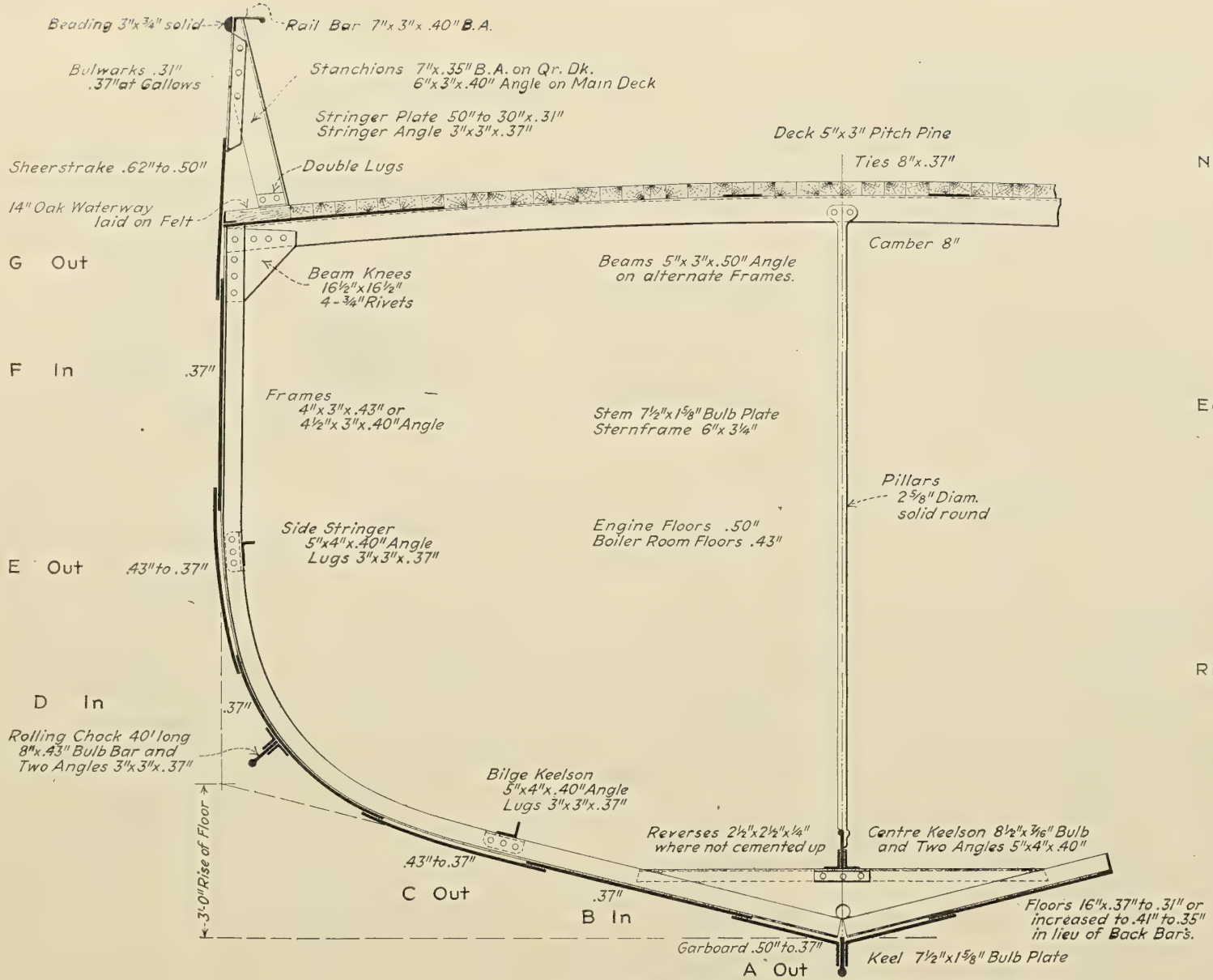


Fig. 3.—Midship Section, S. S. Rudyard Kipling

Numerals.

B+D = 23.62 + 13.50 = 37.12 Transverse
(B+D)xL = 37.12 x 138.33 = 5134.80 Longitudinal
Depths in Length = 10.24
Breadths in Length = 5.85
Depth "d" to Upper Deck = 12'-2".

Equipment

1st Bower 8 Cwts. — Stockless
2nd Bower 7¼ Cwts. — Stockless
Kedge 3¼ Cwts. Ex Stock
120 Fms. 1 3/16 Stud Link Cable
60 Fms. 6" Hawser
60 Fms. 5" Warp

Riveting

Butts of Shell lapped and double riveted except Garboard and Sheer which are strapped and double riveted.
Shell Seams double riveted.
Bulwark Seam single riveted.
Rivets in Keel, Stem, and Sternpost, 1" Diam.
Shell Rivets ¾" Diam.

S. S. Paris Starting on Trial Trip at Base des Glenans on June 5, 1921; Average Speed on Trials, 22.4 Knots

New French Passenger and Mail Liner Paris

Largest and Most Luxurious Vessel Ever Constructed in France to Ply Between New York and Havre

ALTHOUGH not so large as the *Olympic* or *Imperator* and not intended to challenge the speed record of the *Mauretania,* the *Paris,* operated by the Cie Generale Transatlantique, is one of the finest liners put into service in recent years. The opinion of those who have seen the *Paris* is that she has established a record for luxury and good taste in steamship accommodations that will not be equalled for many years.

After the *Olympic* had been converted to an oil burner Lord Pirrie on the trial trip referred to that vessel as the one "ewe lamb" of the White Star fleet. This saying has been interpreted to mean that there was little likelihood in the near future of the construction of new giant fast liners of the *Olympic* type because of the high cost of building and the excessive consumption of fuel for the few extra knots of speed. On this account the Cie Generale Transatlantique is to be congratulated for its business acumen in sparing no expense to make the *Paris* the most elaborately equipped vessel in the transatlantic service.

Started in 1913

The *Paris* was laid down in 1913 and was to have been ready for service in 1916. The great war, however, interrupted the work so that she was not launched until September 12, 1916. Shortly after the armistice, work was resumed and on June 15 of the present year the vessel sailed from Havre for New York on her maiden voyage.

The *Paris* was constructed at the Chantiers et Ateliers de Penhoët à St. Nazaire. She is designed to satisfy the requirements of the International Convention for the Safety of Life at Sea and the American and French shipping laws. She is constructed to have the highest rating of the Bureau de Veritas with the mark of special surveillance.

General Arrangement

The *Paris* is a vessel with a straight stem, elliptical stern, two pole masts and three funnels.

The accommodations are distributed over five decks and there are five holds, two forward, which are used exclusively for passengers' luggage, and three aft, in which are carried mail and other cargo.

A special feature of this liner is that it is furnished in modern French style, in this respect differing from most other ships which have adopted a Renaissance period for their decorative scheme.

The main saloon, located on *B* deck forward, is 84 feet long, 50 feet wide and 24 feet high. A mixed saloon, of about the same dimensions, is located on *B* deck abaft the main saloon; between the two is the main stairway and foyer. Smoking rooms are provided aft of the mixed saloon and occupy spaces on both *B* and *C* decks. The first class dining saloon is amidships on *E* deck and extends also to a balcony on *D* deck. A dining saloon for the second class is located on *E* deck aft. On *C* deck amidships is located the grand social hall and information bureau.

There are 141 first-class cabins with single berth accommodations, 163 with double and 32 which may be comfortably occupied by three persons. Included in the total number of first-class accommodations are 89 luxurious suites with boudoirs, drawing rooms and private bath.

The second-class cabin of the *Paris,* which accommodates 468 passengers, is proportionately luxurious in every way.

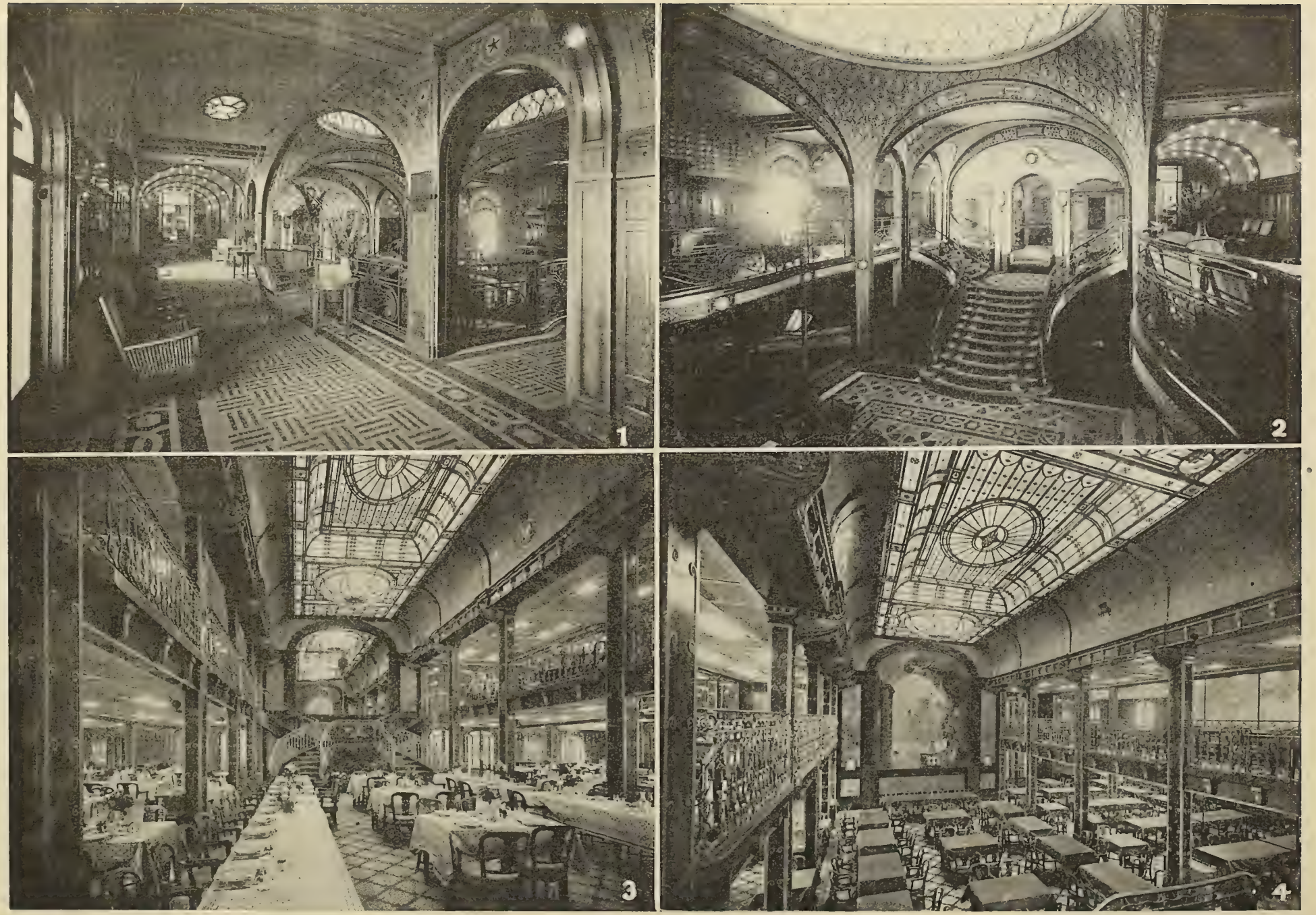
Provision is made for the accommodation of 1,100 third-class passengers in cabins and 1,110 steerage in open berths.

Main Propelling Machinery

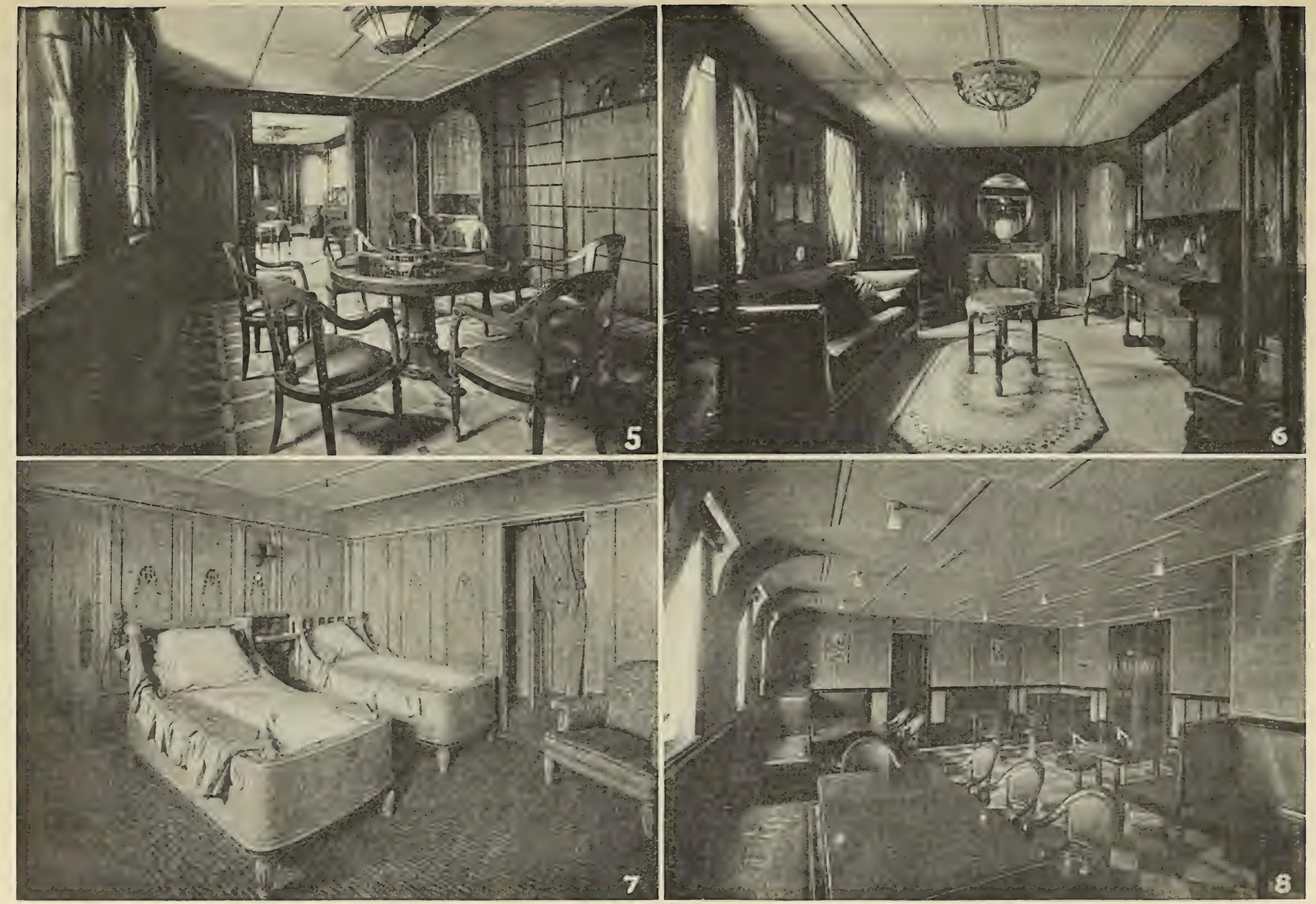
The propelling machinery was built by the Wallsend Slipway & Engineering Company, Ltd., at Wallsend-on-Tyne, and consists of four turbines of the Parsons type. Two low pressure turbines are flanked by one medium pressure on the starboard side and one high pressure on the port side. For maneuvering purposes there is a mechanism on board which makes independent the starboard and port engines, permitting the reversing of the engines on one side of the vessel while those on the other side are running ahead when making a turn. This operation is directed from the bridge by means of Chadburn instruments.

Steam is generated in fifteen double ended boilers of the Scotch type containing four furnaces in each end and making a total of 120 furnaces. All boilers are fitted for oil burning.

The sea trials of the *Paris* took place at Base des Glenans from June 5 to 9, 1921. The vessel was originally designed for a speed of 21.75 knots but during the trials averaged a speed of 22.4 knots, although only 12 of the 15 boilers were in operation. At one time, however, a speed of 23 knots was recorded with a minimum of vibration.



Interior Views, S. S. Paris: (1) Top of Grand Stairway, B Deck; (2) Main Stairway, First Class; (3) and (4) Dining Room, First Class



Interior Views, S. S. Paris: (5) Palatial Suite, (6) Drawing Room in Palatial Suite, (7) Average First Class Stateroom, (8) Children's Dining Room

New French Passenger and Mail Liner Paris

General Information

Service: Passenger-Mail. Havre and New York.
Builder: Société des Chantier et Ateliers de Penhoët à Saint Nazaire.
Owner: Cie. Générale Transatlantique (French Line).

Characteristics

Length, overall	768′ 3″
Length, B. P.	735′ 5″
Breadth, molded	85′ 4″
Depth, molded	68′ 0″
Draft, loaded	31′ 1½″
Draft, light	
Block coefficient	
Midship section coefficient	
Longitudinal coefficient	
Speed, loaded, knots	23
Cruising radius, nautical miles	8,000
Framing	Transverse
Class: Highest Class, Bureau de Veritas	

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull / **Weight Propelling Machinery	26,600
Deadweight Capacity	10,095
Displacement	36,695

(In tons of 100 cubic feet)

Gross register	35,000
Net register	

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.
**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez		
Panama		

Equipment

2 Bower anchors, each	19,551 lbs.
Auxiliary anchor	15,963 lbs.
Emergency anchor	6,710 lbs.
Emergency anchor	3,355 lbs.
Chain	361 fms.

Rudder

Area	
Dia. Stock	
C. Press. abaft C. L. pintles	

Complement

Deck officers	7
Wireless operators	3
Deck crew	60
Engineer officers	21
Engineer crew	103
Purser's and steward's department	463
Total officers and crew	657
First-class passengers	563
Second-class passengers	468
Third-class passengers	2,210
Total passengers	3,241
Total complement	3,898

Handling Equipment

	No.	Type	Capacity	Length
Masts	2	Pole	....	....
Derrick posts	....	....	....	....
Booms	9	....	6 ton	....
Electric cranes	2	....	2 ton	....

Deck Machinery

(Number, Size, Type)

Steering Gear	Hydraulic type
Windlass, capstan type	2
Capstans	14
Winches, electric	6
Winches, steam	6

Life Saving Equipment

	No.	Type	Length
Lifeboats	30	MacLean	30′-0″
Lifeboats	24	Seamless	30′-0″
Motorboats	1	de Coninck	30′-0″
Service boats	2	.....	.....

Propelling Machinery

Boilers

Number	15
Type	Scotch, double ended
Length	21′-9 ″
Diameter	17′-9⅞″
Furnaces, total	120
Fuel	Oil
Draft	Forced
Total heating surface, square feet	6,500
Total grate surface or furnace volume	
Superheat, degrees F	None
Working pressure, lb. per sq. in	214
Normal fuel consumption:	
Per day, tons	360 @ 20 knots
Per day, tons	400 @ 23 knots
Per horsepower hour, pounds	
Normal steam production:	
Per hour per pound of fuel	lbs.
Total per hour	lbs.

Engines

Number	4
Type	Parson's turbines
Size	
Horsepower	46,000

Propellers

Number	4
Type	4 bladed
Weight, each	7.5 tons
Diameter	12′-3″
Pitch	11′-6″
R. P. M., 20 knots	205
R. P. M., 22 knots	225
R. P. M., 23 knots	240

Auxiliary Machinery

(Number, Size, Type)

Machinery Space

Condensers, main	2
Condensers, auxiliary	2
Evaporators, 4 at 120, 2 at 60	6
Distillers, 20 tons each	2
Filters	
Feed water heater, 2 groups	2 each
Fuel oil heaters	10 Wallsend Slipway & Engineering Co.

Pumps

Fuel oil	10

Refrigerating Machinery

Otto Fixary Co.	Ammoniac type

Electric Equipment

Generators (3), 450 K. W., 100 volts
Radio
Emergency (1), gas engine type on B deck

Holds

No.	Length	Hatches
1	67′- 0 ″	16′-9 ″ x 14′-5″
2	65′- 7 ″	18′-0 ″ x 14′-5″
3	62′- 7½″	17′-4½″ x 14′-5″
4	57′- 1½″	17′-9 ″ x 14′-9″
5	58′-10½″	

Capacities

Cargo Space

Compartment	Cu. ft.
Total volume of holds	123,620

Refrigerated Space

Compartment	Cu. Ft.

Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons
Oil fuel carried in 24 bottom tanks, and 22 vertical tanks			6,161

*....cu. ft. per ton; .....gals. per bbl.

Tanks

Compartment	Cu. Ft.	Tons F. W.	Tons S. W.
Total			

Government Inspection of Merchant Vessels

By Commander J. B. Patton, U. S. N. (Retired)

In this paper the United States rules are compared with the rules of the British Board of Trade and the rules of the classification societies. It is realized that the manner of application of the rules is more important than the letter of the rules.

GOVERNMENT rules properly relate to the safety of life of passengers and crews and not to safety of property, but they should serve to prevent the owner from injuring the property of others, by collision, for instance. They properly provide for licenses of officers, navigational aids, signal lights, rules of the road, etc. They protect the sanctity of contract between owner and employee and between owner and shipper and underwriter.

The owner, underwriter and classification society have a common interest in rules for the protection of property. They rely on government rules for safety to life and prevention of fire damage.

Interested Parties

(1) The Nation (Army and Navy Reserves).
(2) The Government.
  Commissioner of Navigation.
  Shipping Commissioners.
  Custom House.
  Steamboat Inspection Service.
  Public Health Service.
  International Conference.
  (British Board of Trade.)
(3) Shipowners.
  American Bureau of Shipping.
  Lloyd's Register of Shipping.
  Underwriters of Hull.
  Steamship Owners Indemnity Association.
  Shipyards and Harbor Service.
(4) Shippers.
  Underwriters of Cargo.
(5) Passengers.
(6) Crew.

A brief outline of the rules is given under the following headings:

I. Hull, Boilers, Machinery, Equipment.
II. Lifeboats and Fire Apparatus.
III. Loading and Stowage.
IV. Tonnage.
V. Crew Space.
VI. Manning Scale.
VII. Surveys and Inspections.

I.—Hull, Boilers, Equipment

United States Rules

The Steamboat Inspection Service has very few rules for the hull, except those required by international agreements, such as the bulkhead requirements. But the rules of the American Bureau of Shipping are adopted as standards. The substance of the requirements are indicated below:

(1) Owners are to submit drawings of new ships.
(2) United States inspectors supervise repairs and alterations and examine ships when dry docked.
(3) Living compartments to have two avenues of escape.
(4) Auxiliary steering apparatus required. Mechanical sounding machine required.
(5) To have a collision bulkhead, stern bulkhead, machinery space bulkheads and intermediate bulkheads not over 80 feet apart. These bulkheads to reach to the *second deck,* if the ship has two or more decks.
(6) Submit drawings of fuel oil tanks; suction pipes to settling tanks must have internal gate valves with rods to upper deck.
(7) Tail shaft to be drawn every three years.
(8) Fit safety guards around machinery.
(9) Make inclining test when stability is doubtful.
(10) Examine air ports and inspect accessible parts of hull.
(11) Steam pipes not to touch wood.
(12) Bilge pump suctions and sounding pipes in each hold.
(13) Electric rules are not stated fully. "Best modern practice" is required. Single wire system is not mentioned or disapproved.
(14) Deck hand pumps are not required to have bilge connections.

United States Rules for Boilers

The design, materials and tests are specified in great detail. The rules are in accordance with good modern practice and are about the same as those of Lloyd's Register and the British Board of Trade. The material specifications are not difficult but the detailed inspection at the works is possibly unnecessary at this date and may inconvenience the manufacturers.

There are some obsolete laws such as the rule for obtaining the working pressure on cylindrical shells, which is:

"Multiply one sixth of the tensile strength by the thickness of plate, and divide by the radius in inches, plus 20 percent when the seam is double riveted." The Supervising Inspector General has recommended the repeal of this.

(1) Submit drawings for approval.
(2) Pressure allowed on cylindrical shells.
(3) Pressure allowed on flat surfaces or curved heads.
(4) Man holes, hand holes and pipe connections.
(5) After ten years the boiler shell to be drilled to obtain thickness.
(6) Water test to 1½ times working pressure, when built and annually thereafter, including main steam pipe.
(7) Design of riveted joints (same as British Board of Trade).
(8) Design of butt straps and combustion chambers.
(9) Rules for working pressure of furnaces: $P = \frac{C \times T}{D}$

where C varies from 14,000 to 17,300, according to type of furnace.
(10) The physical test of shell and furnace plate requires only 20 percent elongation, which is easy to obtain.
(11) The tube tests are not difficult, 1000 pounds water test is required.
(12) Fusible plugs in tops of combustion chambers. These plugs appear to be a wise precaution. They are not required on watertube boilers.
(13) Gage cocks, valves, etc. The requirements are about the same as other authorities. A *single* safety valve is required.
(14) Watertube boilers. Design to be submitted for approval. Malleable iron fittings are allowed. On the drums the seams and re-enforcing rings are to be welded. When new, the water test pressure is double the working pressure and 1½ times the working pressure annually thereafter.
(15) The rules permit repair of all boilers by welding, and are in accordance with good modern practice. The rules are similar to those adopted by technical associations for land boilers. Welding is allowed generally on stayed surfaces, and compression members. On parts subject to tensile stress it is only allowed as follows: cracks in shell may be repaired by a spot welded strap; shells corroded only 25 percent of thickness may be built up; manifolds, headers and fittings may be welded.
(16) Main steam pipe. The working pressure allowed on riveted pipes is given by the obsolete law for cylindrical shells. This appears to allow too great a pressure. For lap welded and solid drawn steel pipes the formula for thickness is:

$$T = \frac{P \times D}{10{,}000} + 0.125$$

(17) Lloyd's Register uses the same formula, but the divisor is 9,000 for lap welded and 12,000 for solid drawn steel. The American Bureau allows 10,000 for lap welded, or 12,000 for solid drawn steel.
(17) Pipe fittings, valves, flanges, etc. The materials used and manner of attaching same to boilers are specified in some detail. The qualifications must be guaranteed and stamped by the manu

facturer or an affidavit made. Screwed joints are allowed on boiler connections up to 2 inches, and up to 3 inches elsewhere. Cast iron can be used for temperatures up to 450 degrees, and hard brass up to 550 degrees. For pressures over 300 pounds or temperatures over 550 degrees, cast steel, or a composition of over 50,000 pounds per square inch tensile strength and 10 percent elongation is required. Screwed bonnets are only allowed on brass valves, 2 inches or less in size. Brass fire main valves 2½ inch size have been rejected on account of screwed bonnets. This seems an unnecessary rejection.

The British Board of Trade Rules

The British Board of Trade rules correspond with the work of the Steamboat Inspection Service in the United States, and in addition they have other important duties such as carrying out the laws relating to merchant seamen, Custom House rules, regulation of stowage of cargoes, deck loads, explosives and dangerous goods, tonnage measurement, crew space and approval of the load line mark as fixed by Lloyd's Register. They also have a very important department for the development of overseas trade. The Board of Trade rules for hulls, boilers, machinery, anchors, chains and equipment are specified in detail, and ships are built under their survey, but they correspond very closely with Lloyd's Register. Their surveys are directed principally towards the safety and comfort of passengers and crews rather than the safety of property. Their surveyors' report includes the following items:

(1) That hull and machinery are in good condition, and efficient.
(2) Dry dock examination.
(3) Bulkheads and watertight doors.
(4) Rudder, bottom valves, ceiling.
(5) Hatches, openings in side.

Boilers and Machinery

No survey on donkey boiler or winches.

(1) Shaft and bearings.
(2) Pistons, valves, pump buckets and valves; boiler surfaces and valves. Tail shaft.
(3) Inside of boiler to be examined or else a hydraulic test to double the working pressure. On first survey for certificate, the boilers have a hydraulic test to double the working pressure, and after important repairs to 1½ times the working pressure. It is reported a new rule is coming out fixing the test at 1½ times plus 50 pounds for new boilers.
(4) It is desirable, but not mandatory, to drill staybolts.
(5) Quality of materials and test of steel are specified.
(6) Steam pipes. Copper pipes are tested to twice the working pressure. Every four years main steam copper pipe (brazed) to be tested also. Every six years iron and solid drawn copper main steam pipes to be tested.
(7) Feed pipe to have relief valve. Each boiler to have two feed lines with checks and stop valves. Bilge pipes connected with sea to have a non-return valve.
(8) Spare parts, anchors, chains and shackles to be examined annually. Spare tiller and signals. No mechanical sounding machine required.
(9) Rules for deck pumps are not clear, but appear to be as follows:

> A deck hand pump for each compartment. Or, one deck hand pump connected to bilge suction system, provided there is a valve rod from deck to each suction. Or, no deck pump required if there are duplicate steam pumps and boilers in separate watertight compartments.

American Bureau Rules

The American Bureau has rules in agreement with the British Corporation and the Italian classification society.

(1) Rules for design, construction and tests of steel ships, including oil ships.
(2) Rules for design, construction and tests of boilers, machinery and anchor gear.
(3) Rules for internal combustion engines.
(4) Rules for refrigerating plants.
(5) Rules for electric plants.
(6) Bulkheads extend to upper deck. Watertight doors to be worked from bulkhead deck. Rules are stricter than United States law.
(7) Engine room suction pipe to fore peak tank must have a stop valve at collision bulkhead with rod to deck. A deck pump is required to be connected to bilge drainage system. Rules for anchors are about the same as Lloyd's.
(8) On oil burners, suctions from service tanks must have valves worked from machinery space as well as from weather deck outside of casings of boiler room.
(9) Specifications for ships to carry oil in bulk.
(10) Specifications for ships burning fuel oil.
(11) Specifications for boiler and hull material and engine material.
(12) New boilers are tested to 1½ times working pressure. Watertube boilers to double the working pressure. Headers of cast steel to three times the working pressure. Tubes are tested to 1000 pounds.
(13) Electrical specifications conform to the rules of the American Institute of Electrical Engineers and the National Electrical Code. The single wire system is disapproved.
(14) Rules for tests of anchors and chains.
(15) Spare parts to be carried.

Lloyd's Register

(1) Rules for building of steel vessels including oil carriers and oil burners.
(2) Tentative rules for application of electric welding to ship construction.
(3) Rules for survey and construction of engines and boilers.
(4) Rules for the survey and construction of Diesel engines.
(5) Refrigerating machinery.
(6) Freeboard markings. Collision bulkhead extends to the upper deck. The rule for hand pumps on deck is about the same as the Board of Trade rule.
(7) On oil burners, suction pipes from fuel tanks are to have valves in machinery space, with rods to deck outside of machinery space casing.
(8) Single wire electric system approved, except on ships with cargo oil.
(9) Calculation of working pressure of shells and furnaces.
(10) Copper steam pipes to be given a water test to double working pressure.
(11) Two safety valves required for each boiler.
(12) The rules for bulkheads are more in detail than those found in the American Bureau rules. This subject is in an unsettled state. The requirements are based on the recommendation of the International Conference on Safety at Sea, London, 1914. This conference adopted rules for:

> (1) Ice patrol.
> (2) Lifeboats and certification of lifeboat men.
> (3) Hull construction and subdivision.
> (4) Radio equipment.
> (5) Annual safety or inspection certificates for passenger ships.

II.—Lifeboats, Fire and Safety Apparatus

United States Rules

These rules are very strict and are no doubt the result of many boiler and fire accidents on inland passenger steamers. They are excellent for passenger ships but some of them seem unnecessary for steel cargo ships with small crews of hardy men.

Lifeboats and davits are specified in numbers according to the length of the ship. Take, for example, a passenger ship from 410 to 435 feet in length:

Minimum number of sets of davits, 12;
Minimum number of first class boats, 9;
Minimum capacity (persons), 1,306.

The ship may not be required to have a greater number of boats and davits than needed for the persons on board.

If more than 1,306 persons are on board, the excess may be carried on rafts, provided that three-fourths of the total must be in boats. Boats in excess of the 9 specified may be collapsible boats. If not practicable to put on the full number of davits, the number may be reduced to nine.

If a number of lifeboats longer than 50 feet are provided, a further reduction of davits may be allowed, provided that after a prescribed test it is found that the boats can be lowered in ten minutes.

Passenger vessels of over 2,500 tons *shall* carry one motor lifeboat. On vessels carrying more than six lifeboats, two *may* be motor lifeboats.

Cargo ships are to carry sufficient boats on each side for all the crew.

Boat davits are to be tested and approved.

Boats are to have a cubic capacity of ten feet for each

person. They are to have air tank capacity of one cubic foot in the case of wooden boats, and one and a half cubic feet in the case of metal boats, for each person.

Two Lundin boats may be stowed under one set of davits. At the annual inspection all boats are to be lowered, loaded and the falls tested.

Boats are to be equipped according to rule and certified lifeboat men furnished. The design and inspection of boats and davits and detaching apparatus are specified in detail, but there is a wide choice and no monopoly of makers.

Approved life preservers are required for each person on board. For the above ship 18 ring buoys and nine water lights are required. A line gun and three projectiles are required on all vessels. Storm oil is required for all ships.

The nine first class boats specified are open boats with buoyancy. Others needed may be collapsible boats with buoyancy of approved type. Pontoons and rafts are to be of approved type.

British Board of Trade Rules

Passenger ships, 390 to 450 feet long:
Minimum sets of davits, 12;
Minimum number open boats, 9;
Minimum capacity (persons), 550.

The ship is not required to have a larger number of boats and davits than needed for all persons carried.

The "open" boats have inside buoyancy or both inside and outside buoyancy of approved design, lifeboat type, with pointed ends. Additional boats required may be "decked" boats. The latter may be stowed at davits under an open boat, or may be stowed at davits in nests of three.

Where more than four lifeboats are required, two may be square stern boats with buoyancy. For this size of ship 18 ring buoys are required.

The Board of Trade rules do not allow life rafts. The above scale requires a "minimum" lifeboat capacity for 550 persons and the rules require lifeboat capacity for all on board. One-fifth of the lifeboats may be motorboats (optional).

British cargo ships are to carry lifeboat capacity on each side for all persons on board. If more than two boats are required, one may be a "square stern" boat. If more than three are required, two may be "square stern" boats. Cargo ships require 6 ring buoys and a full set of life preservers.

The design of boats, detaching apparatus and davits is specific in detail. In passenger ships the British rules are about the same as the United States rules.

Foreign vessels in United States ports are subject to United States inspection, but there are reciprocal agreements whereby the inspection of British ships is made according to their rules. British rules do not require line guns, or storm oil.

Fire Apparatus, United States Rules

(1) Axes and buckets and fire extinguishers.

(2) Steam smothering lines, 1½ inch to holds and separate compartments and ¾ inch to lamp lockers and oil rooms. Carbonic acid gas or other approved gas may be used instead of steam. Foamite is approved for oil tankers and oil fuel compartments. Fire lines and hose are tested to 100 pounds pressure, and a relief valve is to be fitted. The size is to be not less than the discharge of the fire pump, but it is customary to use 2½ inch hose, or 1½ inch on the smaller vessels. The arrangement of the fire main and hydrants must be so that one 50-foot hose will reach any part of the ship, except on iron cargo ships where it is sufficient for it to reach any part of the cabins or superstructures.

Passenger ships require two hand fire pumps, with sufficient hose to reach any part of the ship. Cargo ships require one such pump. If the pump discharges into the fire main, the extra hose is not required. These laws are not clearly stated, and appear to need revision.

(3) Electric alarm bells worked from the pilot house are to be placed in sleeping quarters when no watchmen are on duty. These alarm bells and "safety first" signs seem unnecessary on cargo ships.

(4) Automatic fire alarm in passengers' sleeping quarters and other compartments not under observation of officers and crew. This appears to be a good thing on passenger ships. The only approved systems mentioned in the rules are the Rich system and the Aero alarm system.

(5) Automatic water sprinklers are required on passenger ships, in galleys and sleeping quarters below the main deck.

(6) Auxiliary lighting set. This is not required if oil lamps are provided and kept lighted at night. This must be above the main deck and furnish light to show passengers to the exits and boats.

(7) Radio set for all ships having over 50 persons on board. To have auxiliary power good for four hours, a range of 100 miles, and an operator continually on watch. United States laws require one licensed operator and one assistant. (International Agreement.)

The British Board of Trade rules are rather brief. Passenger ships are required to have the fire main and hose so arranged that two lengths will reach simultaneously the holds, bunkers or living quarters (to be tested annually). Nothing is said about cargo ships. Steam smothering lines are sometimes seen on British cargo ships.

Radio apparatus is required on all British ships over 1,600 tons gross, and on similar foreign ships in British ports.

III.—Stowage of Cargoes, Explosives and Dangerous Goods

United States Rules (Sections 4278-4279)

Nitroglycerine or dynamite is not allowed on passenger ships nor on freight ships unless packed and marked accordingly to rule.

Section 4288. When acids, matches, lime or gunpowder are delivered to a ship, written notice of the nature of the goods must be furnished to the master.

Section 8, Law of 1882, forbids certain explosives and dangerous goods on immigrant ships.

The Supervising Inspector General in his last report to the Secretary of Commerce has recommended that the following laws be amended or repealed and that the Inspector General be authorized to formulate regulations for the carriage of dangerous goods on ships:

Section 4422, allowing gunpowder on passenger ships having magazines (repeal).

Section 4472, regulating dangerous goods on passenger vessels (amend).

Section 4475, regulating marking of explosives and dangerous goods (repeal).

In amending Section 4472 it is noted that he retains the clause specifying kerosene oil for stores on passenger ships to have a fire test of 300 degrees. This seems too high, as fuel oil of 150 degrees test is being safely used on passenger ships.

The Inspector General is undoubtedly right in his proposal to amend obsolete laws, and to formulate modern and complete rules. However, there is a danger to the life of commerce when he intimates extending passenger ship rules to freight ships as approved by the classification societies.

The rules for transportation of explosives and dangerous goods by rail were formulated and to a certain extent are executed by the Bureau of Explosives of the American Railway Association, and approved by the Interstate Commerce Commission. Any new rules for ocean transportation should be submitted by the owners, shippers and underwriters and approved by the government.

The question is now settled by the recent law of March 4, 1921, section 323, which directs that the Interstate Commerce Commission make rules for the safe transportation of dangerous articles on ships departing from or arriving at American ports.

The master of every sea-going vessel shall, whenever leaving port, enter the maximum draft of his vessel in the log book. The master shall see that the hatches are secure. The owner or master is required to see that the cargo is properly stowed and the ship seaworthy.

The United States has no rules as to load line, or deck

loads, or stowage of grain or lumber. The owner protects himself by employing a representative of the underwriters and getting a loading certificate, showing the draft forward and aft.

The British Board of Trade has rules controlling the deck load, grain cargoes, dangerous goods and load line. They co-operate closely with commercial bodies and have adopted Lloyd's rule for the load line and the rules of the National Board of Marine Underwriters at New York, New Orleans and Mobile, the Wheat Tariff Association of San Francisco, for grain cargoes.

Freeboard

The freeboard on British ships is fixed by Lloyd's Register, the Bureau Veritas, or British Corporation, and the load line is marked according to the Board of Trade rules. The Board of Trade, after approval of the mark, issues a certificate. Foreign ships may receive a certificate direct from Lloyd's, or the American Bureau, or from the other classification societies.

Tonnage openings may affect the load line as shown in the following rule of the Board of Trade:

"As regards all vessels which have deck erections in respect of which deduction has been made for freeboard, if any change tending to invalidate the right to such deduction is made in the structural condition of the deck erections, the certificate of approval of load line shall, therefore, cease to have effect."

IV.—Tonnage

The United States rules for measurement of gross and net tonnage are about the same as the British rules.

Shelter deck space with tonnage openings and deck structures with tonnage openings are now exempt from measurement for gross tonnage. Double bottoms and other places for water ballast are also exempt from gross tonnage.

The cutting of tonnage openings and the measurement of light and air space over engine and boiler spaces, above the upper deck, are optional with the owners.

Passenger quarters above the first tier on the upper complete deck are exempt.

British rules do not exempt such passenger quarters, nor do they exempt deep water ballast tanks, but the latter are deducted for net tonnage. If sheltered places that are exempt have a deck cargo in them, the space is taxed by British rules.

The deductions from gross tonnage to obtain net tonnage includes machinery spaces, crew accommodations, store rooms, etc., and are about the same under United States and British rules.

V.—Crew Space

United States Rules

"Lodging space" for the crew is to have 16 square feet of deck space and 120 cubic feet of air space for each man. One berth must be provided for each man, and not more than one over another. Crew's quarters are to be lighted, heated, drained, ventilated and protected from the weather.

The law does not mention mess rooms. These are sometimes arranged in the lodging place.

(1) Ships with 12 or more seamen to have a separate compartment for a hospital, containing one bunk for each 12 men, but not more than 6 are required.

(2) Ships having 10 or more men on deck to have a washroom with one washing outfit for each two men of the watch. If there are more than 10 engine and fireroom men, washrooms are required large enough to accommodate one sixth of them at one time, and to have hot and cold water, basins, sinks and showers.

The British rules are not as liberal as the United States rules.

(1) Each man is entitled to 15 square feet of deck space, and 120 cubic feet of air space, of which at least 12 square feet and 75 cubic feet must be for their sleeping place, and the remainder for messrooms and bathrooms. Mess tables and seats to be in the sleeping room unless provided elsewhere.

Hospitals and washrooms may be provided and deducted from net tonnage. They are not required.

(2) Light, heat, drainage, ventilation and protection against weather and from bad odors are specified in great detail. Steel decks overhead must have a wood deck laid on them. Floors of crew space to have a wood deck. Bare steel surfaces to have cork cement.

The Norwegian rules require about the same amount of space, but each two men must have a separate room.

Steerage Passengers

The United States rules as regards space are a little more liberal than British rules. The United States rules apply to all vessels coming to this country, so that American ships are under no handicaps. Each passenger is entitled to 21 square feet on the lower deck and 18 square feet on the upper deck. The British rules are 18 and 15 square feet.

VI.—Manning Scale

United States Rules

The United States law requires:

Master and three mates.

Licensed engineers.

Licensed radio operator in charge.

Officers to be citizens.

On mail subsidy ships, one half the crew to be citizens, and such ships to carry one cadet for each thousand tons (gross).

On all ships 65 percent of crew to be able seamen (must be 19 years of age and have three years service on deck and on ocean or lakes). They may be rated able seamen after one year's service and a special examination, but not more than one-fourth of the able seamen may be of this class. Seventy-five percent must understand any order given by the officers.

Certified lifeboat men amounting to 4 to 6 percent of the total number of crew and passengers.

Sailors are to be in two watches and firemen, oilers and water tenders in three watches. At least two radio operators on ships having more than 50 persons on board. In port no unnecessary work on holidays, and nine hours work day.

The remainder of the complement is fixed by the local inspectors. Their rules give usually a minimum of four engineers.

The manning scale fixed by the government inspectors is not excessive, and it is usually less than that which the trade unions demand from the owners.

British Rules

International agreement requires certified lifeboat men and radio men.

Foreign going ships require a master, two licensed mates and two licensed engineers. Officers are not required to be British subjects.

Ships carrying more than 50 steerage passengers are called "emigrant" ships. They must carry "deck hands" amounting to approximately 5 to 7 percent of the total number of persons on board. For a 3,000 horsepower ship, approximately five engineers, one deck engineer, three oilers, one storekeeper and one fireman for each furnace (18 square feet of grate surface) are required.

Foreign going ships must have deck crews as follows:

Ships over 700 tons gross to have one master, two mates, six "efficient deck hands"; ships over 2,500 tons: one master, two mates, eight "efficient deck hands"; ships over 5,500 tons, master, two mates, ten "efficient deck hands."

In regard to the crews there are no qualifications except that men shipped in the United Kingdom or in the Channel ports must have sufficient knowledge of English to understand necessary orders, but this does not apply to any British subject or inhabitant of any British Protectorate, or to any Lascar. Discharge tickets are given and are considered important when shipping men. Owners also consider trade union rules.

VII.—Inspection and Surveys

United States Rules

Ships are inspected annually, and whenever any important repairs are going on. Boilers and main steam pipe are given a water test of 1½ times the working pressure. The Inspector General has recommended that this law be amended, so that the Steamboat Inspection Service would decide what hydrostatic test to apply. He does not indicate what new rule he would formulate.

Boilers ten years old are to be drilled at the water level. Fusible plugs are renewed annually, and the fire extinguishers refilled, hose tested, hand pumps tested and lifeboats examined. The report includes information as to whether the ship is seaworthy, the manning scale, passengers allowed; and also if the navigation and other safety equipment is correct.

British Board of Trade Rules

Passenger and emigrant ships are inspected annually. The surveyor's report includes:

That the hull and machinery are sufficient for the service intended, and are in good condition.

That boats, life buoys, lights, signals and compasses are in good condition.

The number of passengers the ship is fit to carry.

Certificates of master, mates and engineers are correct.

Safety valves and fire hose in required condition.

The chain shackles are inspected annually.

The boilers are inspected inside and outside. If unable to enter the boiler, the hydrostatic test of double the working pressure will be given.

There are no detailed rules for the annual inspection of cargo ships.

Boilers are inspected annually after six years. Copper main steam pipes are tested every four years. Iron or solid drawn copper main steam pipes, and auxiliary steam pipes over 6 inches, are tested every six years.

Lloyd's Register—Periodical Surveys

Four year survey. (1) Ship in dry dock. Clear holds and bunkers. Partial raising of ceiling over bilges. Ceiling over tank tops removed. Tanks examined inside and tested. Frames and outside plates to be examined, cleaned and coated. Oil tanks need not be cleaned and examined inside on first survey. Examine wood decks, masts and spars, windlass, pumps, steering gear and watertight doors.

Eight year survey. (2) Same as (1), cables to be ranged.

Twelve year survey. (3) Same as (2), all ceilings removed. All frames and plates to be exposed, rust removed and surfaces coated. Remove some insulation of refrigerative chambers. Plating to be drilled, if necessary.

Sixteen year survey. Second No. 1. Same as eight year survey. Range cables, examine inside of oil tanks. Examine some frames behind insulation of refrigerating chambers.

Twenty year survey. Second No. 2. Same as eight year survey. Examine some framing behind insulation of refrigerating chambers.

Twenty-four year survey. Second No. 3. Same as twelve year survey. Examine scantlings, completely drilling where necessary. Remove all refrigeration insulation. Three holes to be drilled in each strake where not cemented.

Machinery and Boilers

To be surveyed annually, when practicable, and on the dates of special surveys, unless examined within 12 months. Shafts to be examined annually and tail shaft drawn every three years. At the periodical surveys the machinery and boilers will be examined and boilers drilled or given hydrostatic pressure if necessary.

The boilers are to be surveyed when six years old, and annually thereafter. To be drilled and hydraulic test made if necessary.

American Bureau Rules

Four year survey. (1) Ship in dry dock. Holds and bunkers, bilges cleared, and all framing and plating cleaned and recoated where needed. Remove part of bilge ceiling and all of tank top ceiling. Examine inside of all tanks and test all tanks.

Bore the wood decks.

Examine mast, spars, rigging, hatches, ventilators, deck houses and engine casings. Examine steering gear, windlass, pumps and doors.

Eight year survey. No. 2. Same as (1). Range cables.

Twelve year survey. No. 3. Same as (2). Lift rudder. Remove all ceilings and clean the rust off all parts of the structure and re-coat. Drill the plating where necessary. Make complete examination of structure.

Sixteen year survey. Second No. 1. Same as eight year survey.

Twenty year survey. Second No. 2. Same as eight year survey.

Twenty-four year survey. Second No. 3. Same as twelve year survey. Each strake of shell plating to be drilled about amidship, and at not less than one-fourth of the vessel's length from each end. Additional plates to be drilled near machinery spaces, around the counter or where corroded. Deck plating to be drilled. Part, or all if required, of the refrigeration insulation to be removed.

Engines and Boilers

To be surveyed at the time of special surveys to the hull. Tail shaft to be drawn every three years. Boilers to be examined inside and out. If considered necessary, the plates are to be drilled and boilers tested by hydraulic pressure. The main steam pipes will be tested by hydraulic pressure in the case of brazed copper pipe every four years, and in the case of iron or steel pipes or seamless copper pipes, every six years.

The boilers are to be surveyed when six years old, and annually thereafter.

Classing of Ships

The Supervising Inspector General in his last report recommends that the ships be classed by the Government. But he adds that it is doubtful if the Government would pay sufficient salaries to obtain the technical experts.

It is not clear what is meant by Government classification. Classification societies were founded originally by the underwriters for their own information. At present the owners pay for the service; it standardizes construction and forms a basis for the contract between owner, shipper and underwriter. The rules are flexible and subject to conference. Such would not be the case with government rules for shipbuilding.

Conclusion

The United States steamboat inspection rules were formulated by competent officials and they are usually enforced in a common sense manner. But the inspection of cargo ships seems to be too strict and too frequent.

The United States merchant ships do not appear to bear any unreasonable burden due to technical rules. Their success is largely a matter of *personnel* afloat and ashore. There appears to be a tendency of both the Government and shipowners to yield to unreasonable demands of trade unions. The law should encourage Americans to become seamen and there should be no service qualification to become able seamen and lifeboat men and firemen. There are at least eight licensed officers on every ship and they should be able to train green men. It was done on a grand scale during the war, when lifeboats could be safely lowered in a few minutes.

Every day we see boys learning to handle motorboats and automobiles in a short time.

Thirty years ago naval ships were largely manned by foreigners. An American was not at home on board. Training ships for American boys were maintained for years, but the boys would not stay in the service. The training ships will produce officers, not crews. Twenty years ago the Navy began recruiting its young men in the inland towns, principally in the middle West. These men were given a very short training and then put on board the war vessels. These men became well trained and stayed in the service. Our present fine American personnel was built up that way and the foreigner has almost disappeared. These foreigners were good men but, being of various races, a harmonious organization was impossible.

The nation has decided it wants a merchant marine and that means it is going to have it; just how, and when, no one knows. Shipping men know that we are far from it now. Congress has been unwilling to give a subsidy to *steamships;* but it will subsidize the *man* by naval reserve pay, and the ship will profit indirectly.

The Naval Reserve Law of 1916 is a great success. It was administered with the view of making the merchant service help the Navy, and it succeeded. It enabled us to win the war. Now, in times of peace, it could be administered so as to make the Navy help the merchant service, which would help the Navy in the end.

THE REGULATIONS FOR THE NAVAL AUXILIARY RESERVE, (class 3), with some slight modifications, would cover the requirements.

(1) Citizens in the merchant service to be enrolled in a suitable rating (as now). Men seeking employment to be enrolled also.

(2) Reservists employed on ships to be confirmed at once for the retainer pay of two months' pay each year. Naval rating to increase with their employment rating, with little formality.

(3) Officers to be enrolled and confirmed, or promoted and confirmed without any professional examination except a short oral examination on naval customs and discipline. A short instruction book should be furnished. Officers cannot leave their employment to undertake the training on naval vessels, and none should be required. The United States Post Office Department would not give its employees a vacation to undertake reserve training, and a private corporation cannot be expected to do so.

(4) To continue drawing retainer pay, the reservist should continue to be employed in a position with a rank or rating equal to, or greater than, his naval rank.

(5) The regulations should include men in the stewards' department.

After a few years the amount of naval training required could be increased.

The good effect of this plan would not be apparent at once, but it would surely grow in importance.

Curves of Effective Horsepower

For Typical Destroyers, Yachts, Gunboats and Tugs, Covering Speeds of from 10 to 20 Knots

By James L. Bates*

RECENT experience in the preliminary or basic design of underbody for yachts and for other vessels having similar coefficients has shown the need of data so arranged that approximate powers may be readily obtained without the careful calculations which are customary at a later stage when the design has taken a definite form. Such data when available make possible an investigation of dimensions and coefficients and the effect of their variation with a thoroughness not possible when detailed calculations of considerable length are necessary in order to obtain the power for each set of dimensions and coefficients considered.

In the 1920 edition of the *Shipbuilding Cyclopedia,* published by the Simmons-Boardman Publishing Company, New York, there may be found curves of constant effective horsepower for destroyers and fast yachts having values of longitudinal coefficient of 0.62 to 0.66, values of displacement-length coefficient of 40 and 45 and covering speeds in excess of 22 or 23 knots. These curves are applicable only to vessels of the characteristics shown and within the speed range indicated. Even for vessels of this class, it is neither economical nor safe to cruise always at the maximum designed speed. It is usual, therefore, to specify that a given radius of action must be obtained at a selected speed considerably less than the designed maximum. As a result in fixing displacement, dimensions and coefficients, it is desirable to have power data covering the lower speeds, say from 10 to 20 knots. Figs. 1 and 2 have been developed to meet this need.

So much for vessels intended to have high speed: large yachts intended primarily for ocean cruising, coastal passenger vessels, gunboats and certain seagoing tugs cannot wisely be given values of longitudinal coefficient as high as 0.62 or 0.64. Moreover, designers of these classes of vessels usually put much more displacement upon a given length than is contemplated in the plates referred to above. To illustrate the foregoing, see the table below:

CHARACTERISTICS

Type	Length	Displacement	Longitudinal Coefficient	$\frac{\triangle}{\left(\frac{L}{100}\right)^3}$	$\frac{V}{\sqrt{L}}$
Passenger vessel	411	6940	.552	100	1.085
Intermediate type	520	17470	.576	124.3	.832
Yacht	160	568	.59	138.5	.91
Yacht	210	950	.59	102.8	1.31
Gunboat ...	221	1371	.584	127.1	1.075
Gunboat	225	1575	.565	138.5	.8
Seagoing tug	180	950	.578	163	1.05

Evidently all of the above vessels lie well outside the range of the coefficients (both longitudinal and displacement length) covered by Figs. 1 and 2. Accordingly, there have been prepared Figs. 3, 4 and 5, covering powers for vessels having a longitudinal coefficient of 0.56, displacement length coefficients of 100, 125 and 150 respectively and speeds of from 10 to 20 knots.

In the preparation of these plates the writer has based his work upon Taylor's "Speed and Power of Ships," but has made use of experimental model results for typical ships of good form to increase the range covered and to make the curves as nearly representative of actual practice as possible. The accuracy of the results obtained from the curves will depend upon the degree of similarity existing between the

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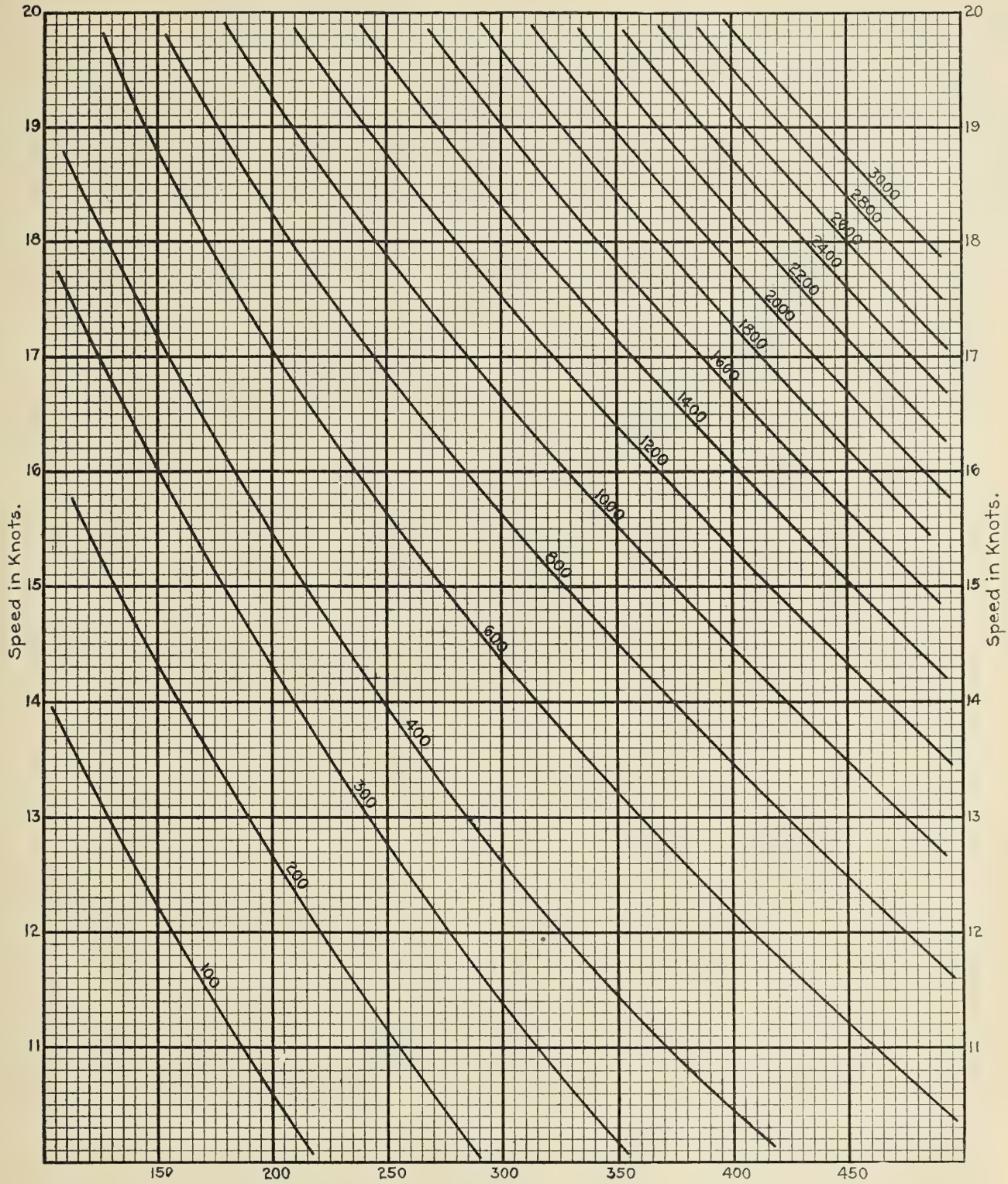
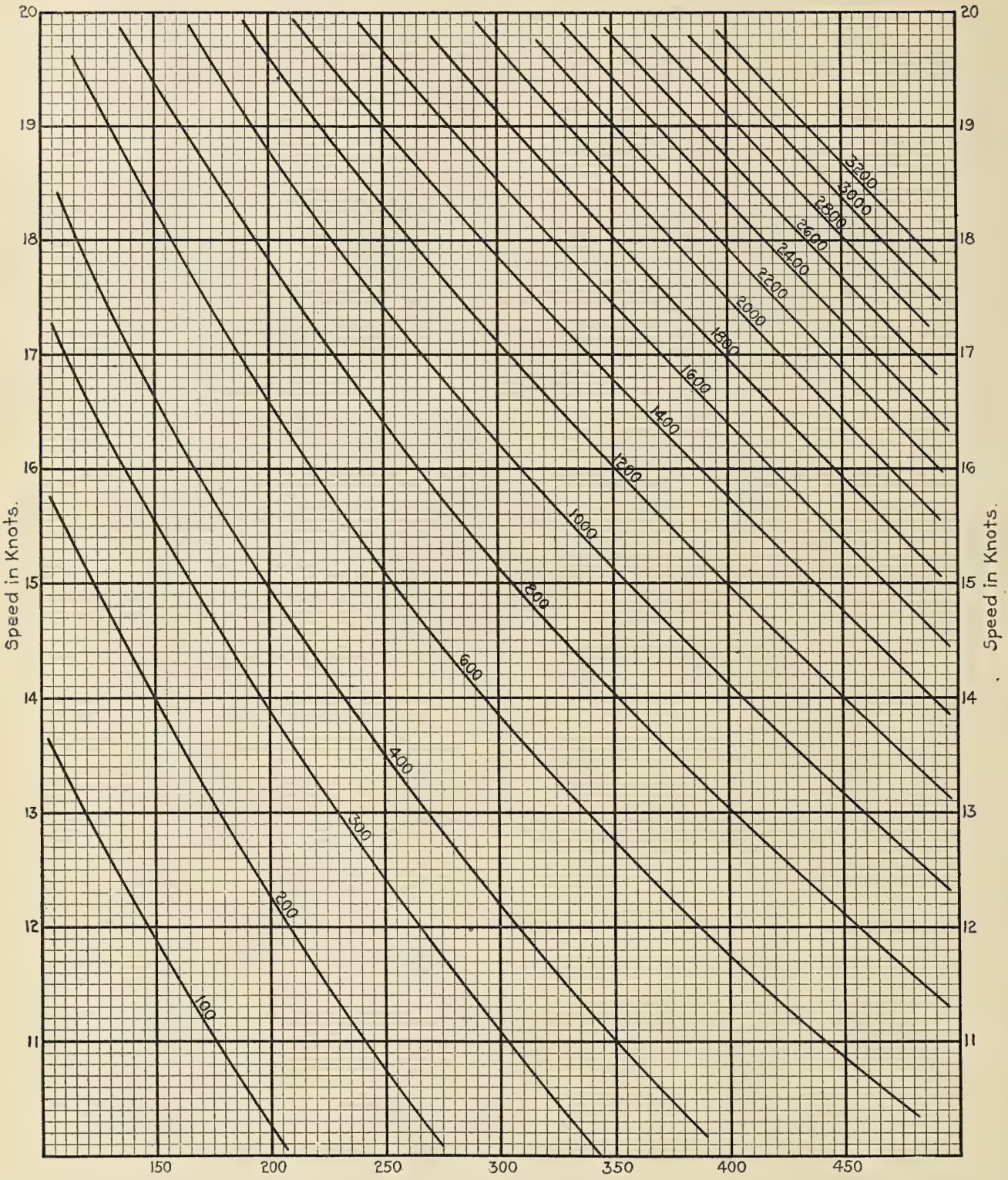


Length of Vessel on L. W. L.

Midship Section Coefficient	= .75 to .83
Longitudinal Coefficient	= .62 to .66
Displacement Length Coefficient	= 40

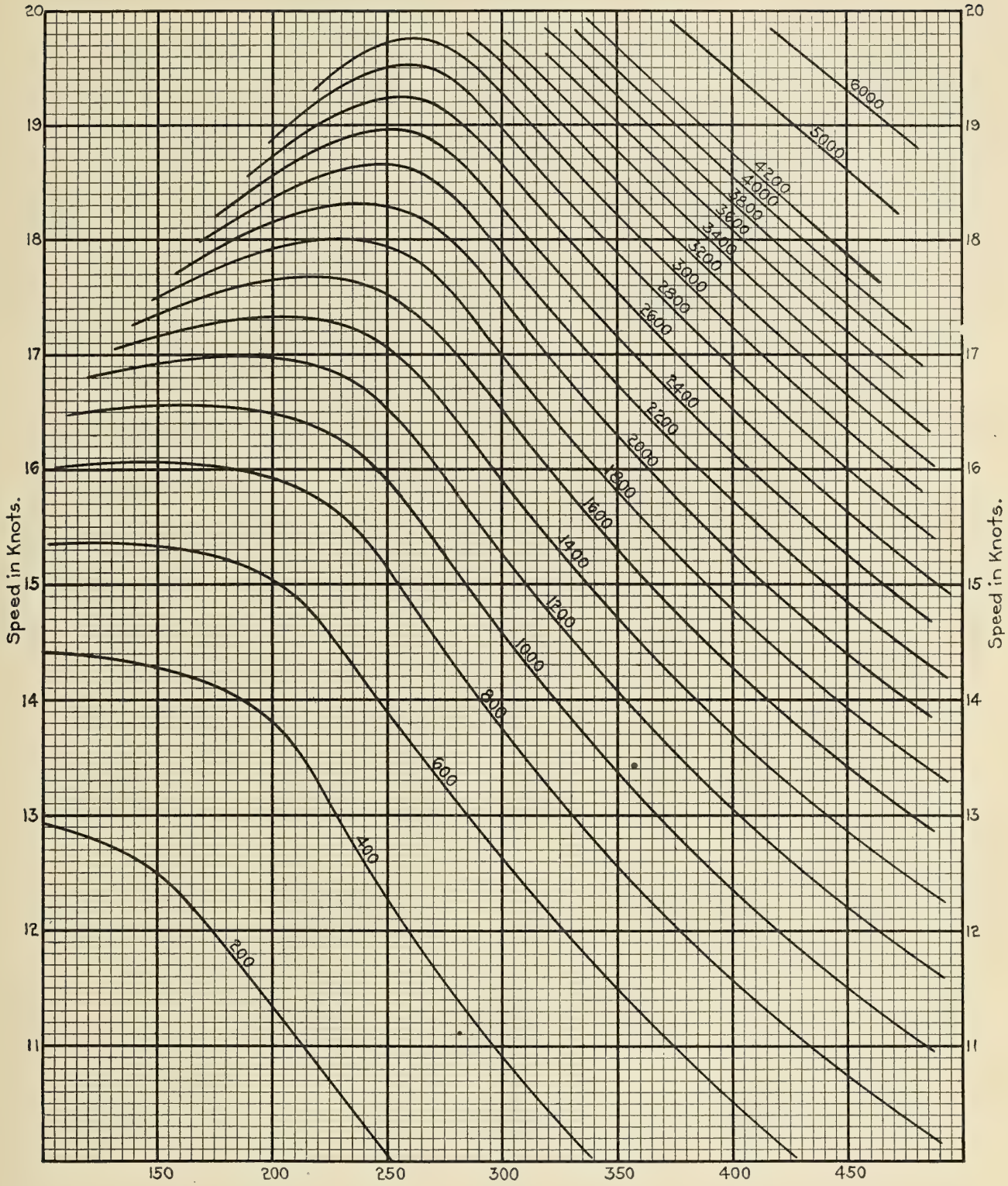
Fig. 1.—Curves of Effective Horsepower for Destroyers and Fast Yachts



Length of Vessel on L. W. L.

Midship Section Coefficient	= .75 to .83
Longitudinal Coefficient	= .62 to .66
Displacement Length Coefficient	= 45

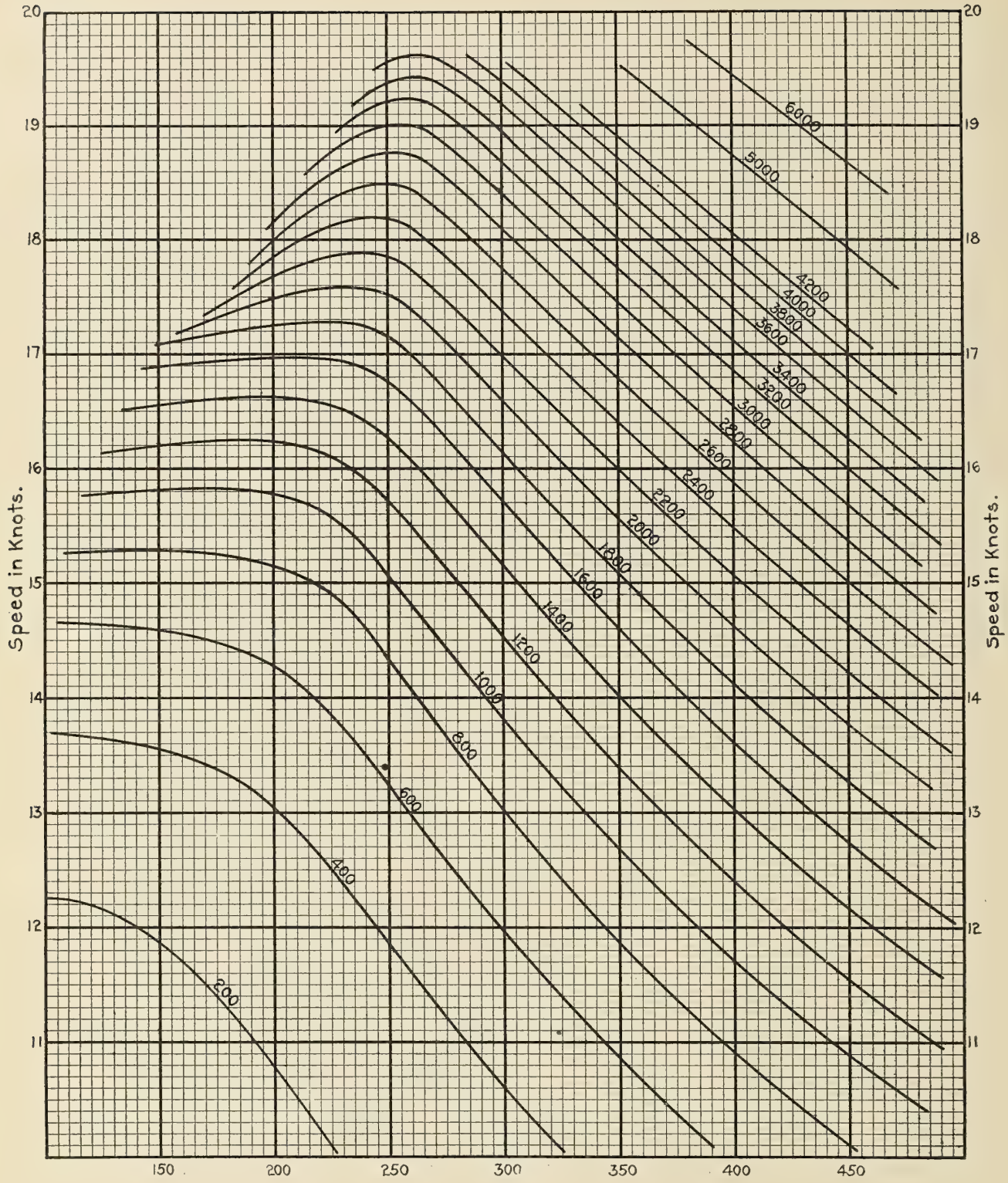
Fig. 2.—Curves of Effective Horsepower for Destroyers and Fast Yachts



Length of Vessel on L. W. L.

Midship Section Coefficient = .87 to 93
Longitudinal Coefficient = .56
Displacement Length Coefficient = 100

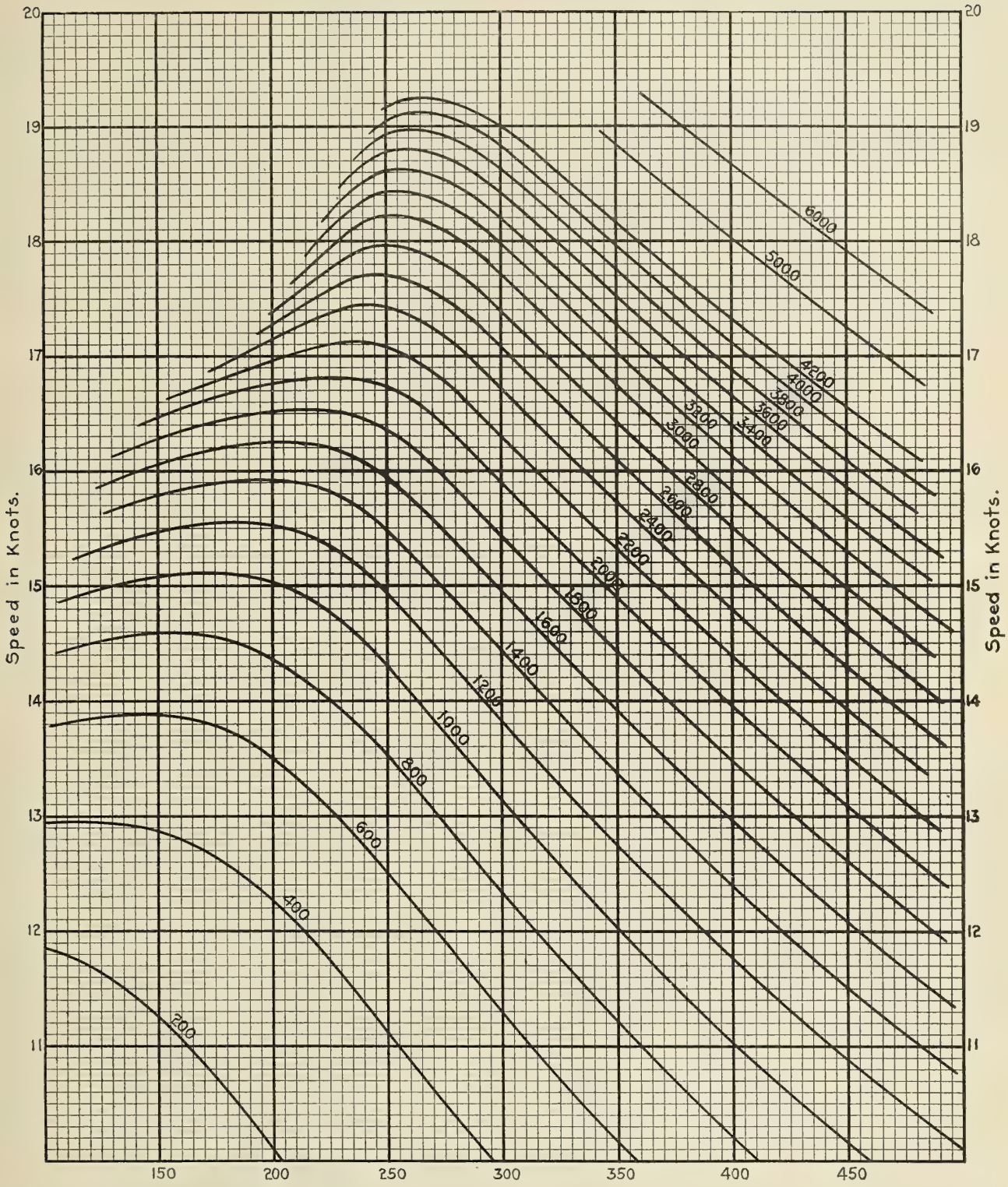
Fig. 3.—Curves of Effective Horsepower for Vessels of Fine Underbody



Length of Vessel on L. W. L.

Midship Section Coefficient = .87 to .93
Longitudinal Coefficient = .56
Displacement Length Coefficient = 125

Fig. 4.—Curves of Effective Horsepower for Vessels of Fine Underbody



Length of Vessel on L. W. L.

Midship Section Coefficient	= .87 to .93
Longitudinal Coefficient	= .56
Displacement Length Coefficient	= 150

Fig. 5.—Curves of Effective Horsepower for Vessels of Fine Underbody

form of the vessel contemplated and the forms upon which the curves are based.

Taylor's standard series curves were based upon a form having high floored or V sections forward and aft with a straight stem and cruiser stern. Most of the forms utilized in preparing the curves in hand are of similar type, but it is believed that the curves are applicable with fair accuracy to vessels with fantail and transom sterns, provided the floors of the sections right aft have a sharp rise.

Fast vessels (with values of $\frac{V}{\sqrt{L}}$ greater than 1.1) having suitable forms of flat stern may be expected to show a considerable saving in power over that as given by the curves.

For somewhat slower vessels a carefully worked out cruiser type of stern (particularly if the load waterline aft be much broadened and the floors flattened so as to secure the greatest lengthening effect upon the vessel's form) is of advantage and should show better results than those taken from the curves.

The use of a bulbous forefoot, such as is fitted in many United States war vessels, is of advantage, provided the draft is great and the speed insufficient to force the forefoot close to the surface when under way. The curves as drawn do not contemplate the bulbous forefoot.

60-Ton Self-Propelling Floating Crane

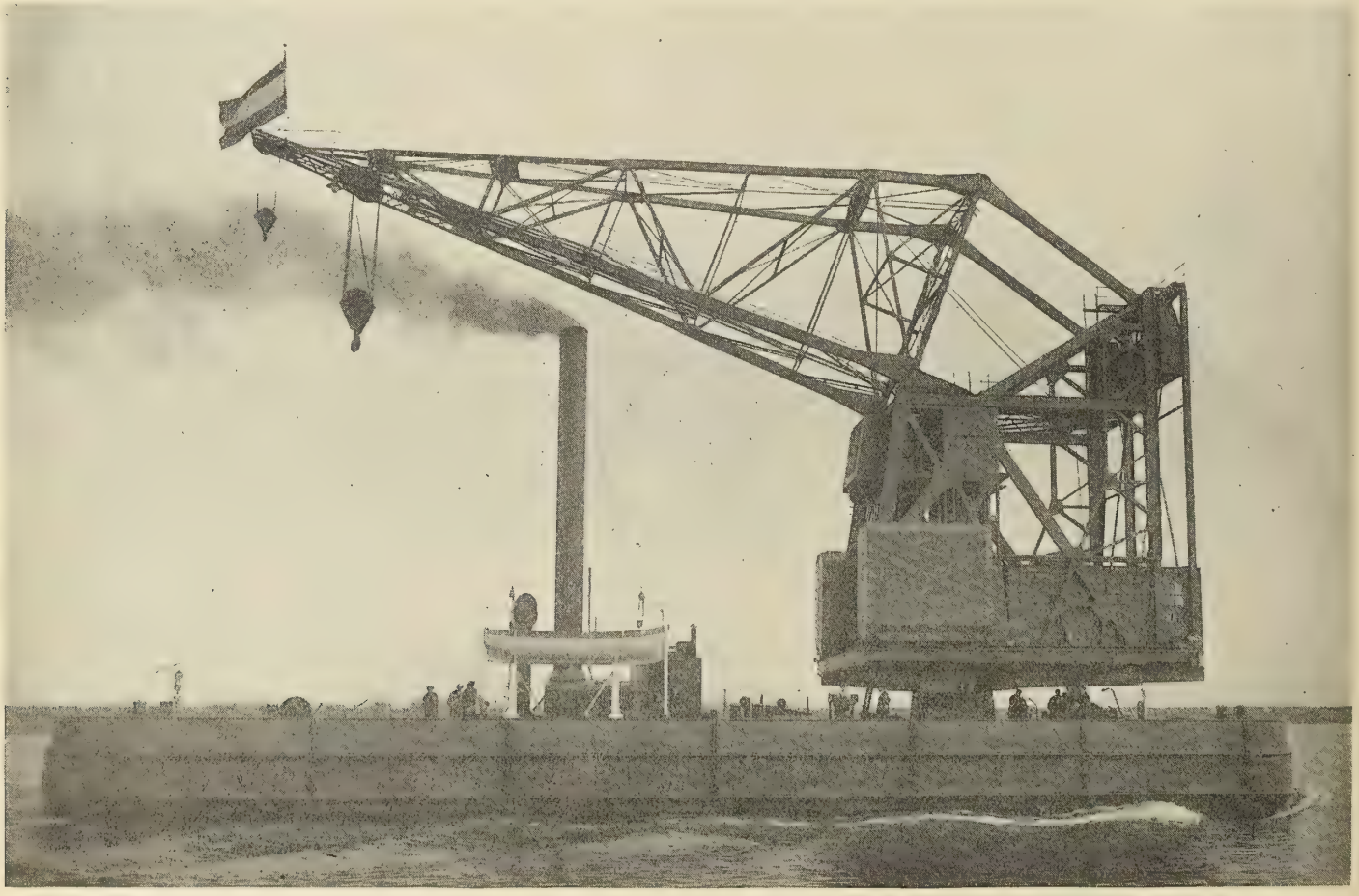
Counterbalanced by Ballast Weights and Controlled from Cabin Placed on Top of the Crane Framework

DURING May, 1921, a 60-ton self-propelling floating crane was delivered by the Werf Gusto. Firma A. F. Smulders, Schiedam, Holland, to the Manchester Ship Canal Company, Manchester, England. The crane is of the "Gusto" slewing and derricking type and is provided with two blocks, one capable of working with loads up to 60 tons and the other for loads up to 10 tons, both so arranged that each can deposit heavy loads on its own pontoon. The loads are counterbalanced by two travelling ballast weights. By means of the latter the pontoon of the crane will remain practically level athwartships while lifting with all loads up to 60 tons.

The maximum height of hooks for the main and auxiliary hoists from the water level at the lowest position of the jib is 65 feet. The hoisting ranges are 75 feet and 120 feet respectively. The maximum radii of the hooks are 60 feet and 76 feet, respectively, corresponding with a distance of 32½ feet and 47½ feet, respectively, clear of the pontoon. The jib can be lowered so that the highest point of the jib is not more than 73 feet above the waterline.

The hoisting speeds are 7 feet and 40 feet per minute, respectively. At the trials a complete revolution with the full load of 60 tons on the main hoist was made in about two minutes.

All the movements of the crane are effected by electric motors of which there are seven in all which are placed in



"Gusto" Slewing and Derricking Crane Built for Manchester Ship Canal Company

the winchroom, situated on the lower platform of the crane tower. The various movements are controlled from the cabin placed on top of the crane framework and the driver, having a clear view not only of the weight being lifted but also of the deck of the pontoon, is able to observe the progress of the work. In front of the driver are the controllers with which he can control any of the motors he requires to effect any desired movement of the crane. In this cabin are also placed the various instruments and gages, including the apparatus for controlling the inclination of the vessel and an indicator on which the position of the jib at any moment can be seen, as well as the distance of the hooks from the center of the tower.

Only one man is required in the control cabin for working the crane. This simplicity of handling is made possible by connecting up the electrical installation by the Ward Leonard system, which enables any load to be lowered or hoisted at extremely low speeds as well as providing many other advantages.

Numerous safety devices are provided, such as electric brakes to all the motor shafts, devices to limit the working range of the various movements, also for guarding against a too heavy electric current.

The dynamos for supplying the current are driven by one of the compound propelling engines. The machinery for the propulsion consists of two sets of vertical compound engines with an independent surface condensing plant.

At the trial trip on the river Meuse a speed of nearly 5½ knots was attained.

There is a very complete equipment of deck machinery and an extensive electric light installation is provided for the pontoons and crane.

The deck aft in the path of the radius of action of the crane is free of all obstacles and especially strengthened so that any heavy weight may be placed on it,

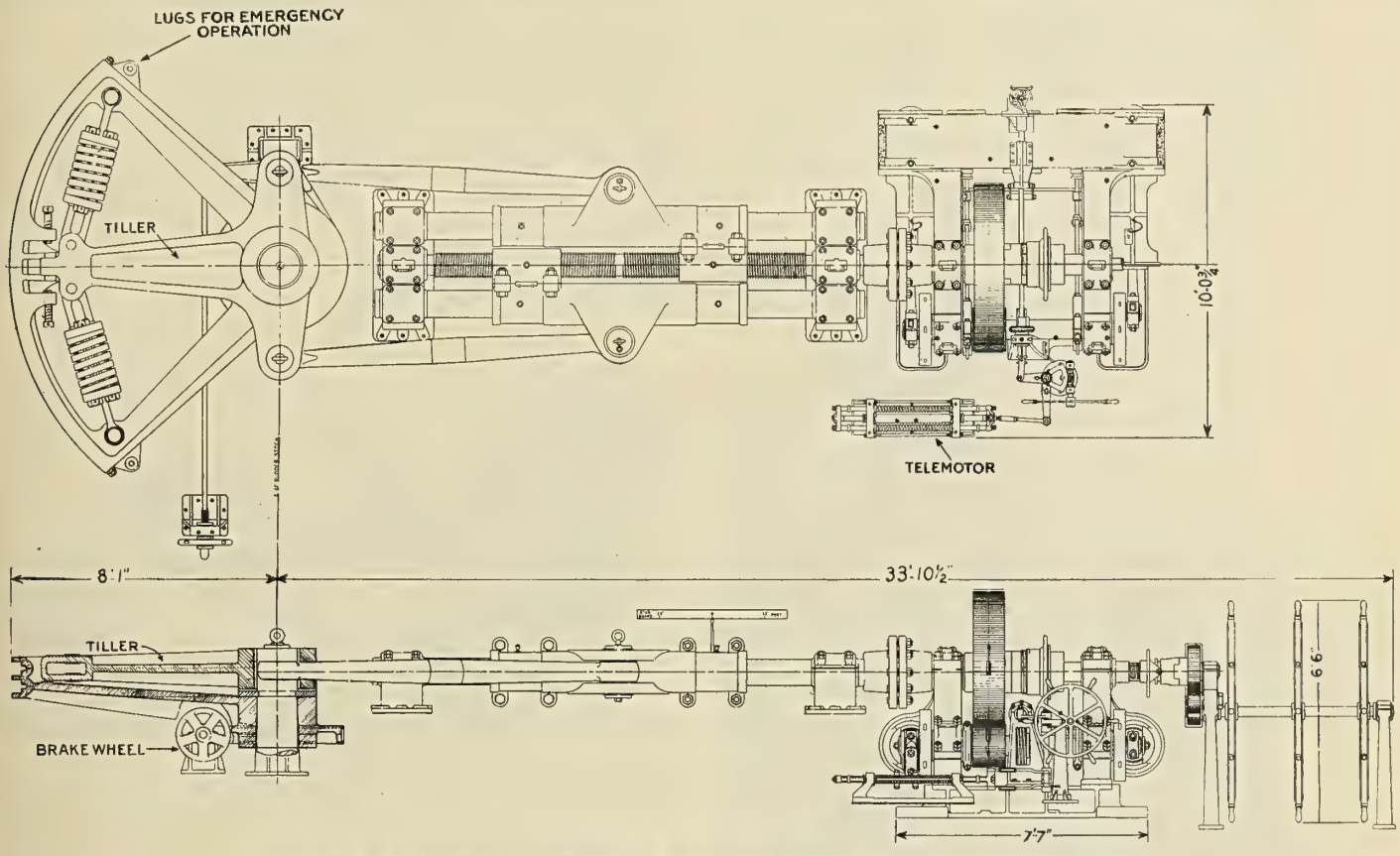
The crane was towed from Schiedam to Manchester without the jib being dismounted.

Combined Screw and Spring Quadrant Steering Gear for Combination Ore Vessels

THE steering gears for use in the 20,000-ton ore-and-oil and ore-and-coal vessels under construction by the Bethlehem Shipbuilding Corporation, Ltd., are being built at the Moore plant of the corporation at Elizabeth, N. J. Four of the vessels, the ore-and-oil carriers, one of which is for the International Petroleum Company, Ltd., and three for the Ore Steamship Corporation, are being constructed at the Sparrows Point, Md., plant; the other two, designed for carrying ore and coal for the Ore Steamship Corporation, are building at the Union plant, San Francisco, Cal.

The steering gear, which is the same design for all six vessels, consists of a Bethlehem standard 16-inch by 12-inch screw steering gear direct connected to the rudder stock through a spring quadrant and tiller, as shown in the illustration. The tiller is free to turn on the rudder stock and is operated by the connecting links of the screw gear. The quadrant, keyed to the rudder stock and connected to the tiller by two heavy springs, transmits the power to the rudder. All shocks between the rudder and engine are taken by the quadrant springs, which are so arranged that they are both in compression at the midship position and, therefore, instantly transmit any movement of the quadrant and screw gear to the rudder stock. This combination provides an extremely powerful gear with the added advantage of transmission through the shock absorbing springs.

For ordinary operation the steering engines are controlled by hydraulic telemotor. A trick wheel, on the same deck as the engines, provides means for control when adjustment of the telemotor is required. For docking purposes the valves of the engines can also be controlled from a steering column located on the engine and boiler room casing and connected up through shafting and bevel gearing. For hand-



Plan and Elevation of Combined Screw and Spring Quadrant Steering Gear

steering the engines can be disconnected and the screw operated by three 78-inch hand wheels located at the forward end of the gear.

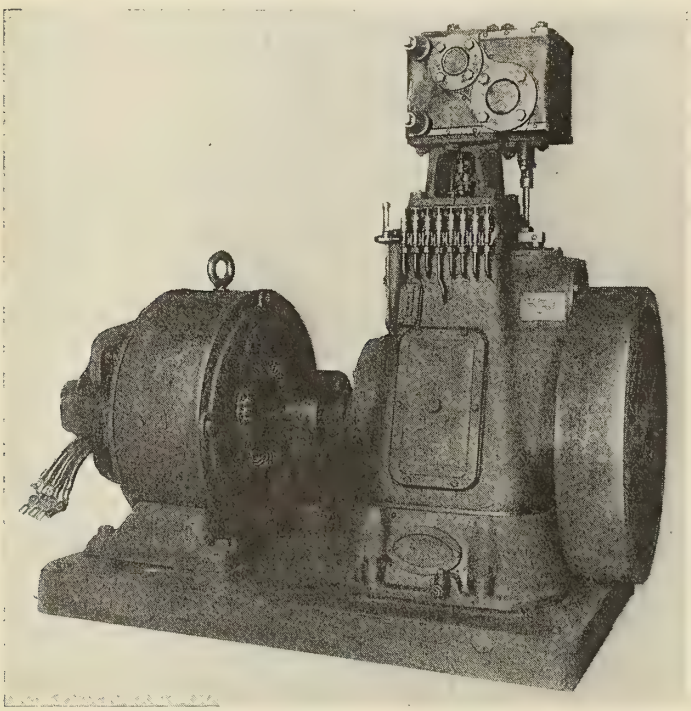
Arrangements are also made for relief steering from a steam winch located on the poop deck. The quadrant is grooved to take chains which are operated from two winch heads by means of relieving tackle carried through deck leaders to the steering gear room. The quadrant, being keyed to the rudder stock, operates the rudder direct.

For emergency steering, lugs are fitted to each side of the quadrant and the rudder stock can be operated by hand through cables attached to the lugs.

Light Weight Engine Generator Set for Marine Auxiliary Service

AUTOMATIC lubrication, elmination of practically all vibration, low piston speed, sparkless commutation and improved voltage regulation are features of a new type auxiliary engine generator unit known as the Westinghouse-Sturtevant marine lighting set.

The engine frame for this unit is oil and dustproof and provided with large openings having cast iron covers located so as to give ready access to all parts subjected to wear. The



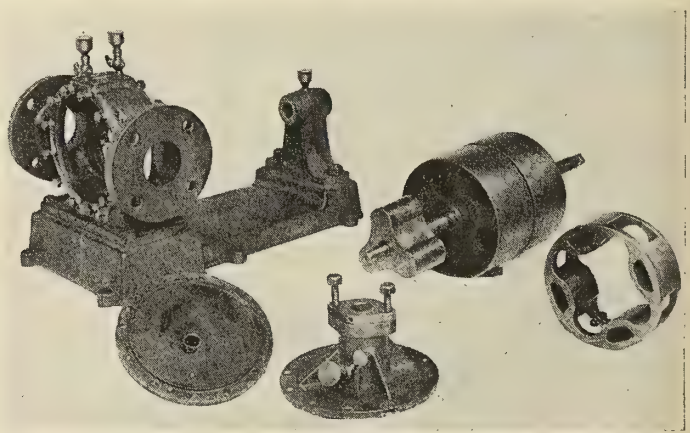
Westinghouse-Sturtevant Lighting Set

oil reservoir for the lubricating system is cast in the top of the frame. In the distance piece, separating the cylinder and the frame, are enclosed a watershed partition and stuffing box together with the piston rod stuffing box. The cylinder is of close grain iron cast in one piece with the valve chest. Relief valves of large diameter which may be adjusted to open at any desired pressure are fitted into the cylinder. The steam valve is of the piston type and operates in a renewable bushing which forms the valve ports. The engine is equipped with an inertia governor of the Pites flywheel type. The piston is of cast iron cored for lightness. The crank shaft is of open hearth steel made in a single forging fitted with balancing counterweights secured to the webs. The lubricating system is automatic, requiring no independent tank or reservoir. In engines having gravity type lubrication the oil is pumped from the reservoir in the base by a chain driven rotary pump to the upper reservoir cast in the top of the frame. In the case of engines equipped with a forced feed system of lubrication the submerged pump forces the oil under pressure through brass pipes direct to all parts requiring lubrication.

The Westinghouse type "S-K" generator forms part of the set. The frame for this machine is forged from open hearth steel. The bearing on the generator is a solid steel shell lined with babbitt metal so constructed that no leakage of oil will occur with the listing of a vessel. Both armature and field windings are impregnated with a special compound for resisting the moisture and salt atmosphere found in marine service. By the application of commutating poles, sparkless commutation has been obtained.

New Principle Adopted in Constructing the Exeter Rotary Pump

THE rotary pump (Feuerheerd patents) produced by the Exeter Machine Works, Inc., West Pittston, Pa., is based on a new idea of rotary pump construction, the underlying principle of which is a variation of the square hole drilling device in which a triangular body functions inside a restraining square former of equal size. In the pump this combination has been developed as a three-toothed gear having the teeth made up in the form of circular arcs meshing with an internal four-toothed gear set eccentrically. As the two gears rotate irregular spaces are formed which as



Parts Making Up One 4-Inch Belt Driven Exeter Rotary Pump, Capacity 215 Gallons Per Minute, on Heads Up to 300 Feet at a Speed of 500 Revolutions Per Minute

they increase and diminish in volume are utilized to pump and eject the fluid.

In detail the pump consists of an outer casing of cylindrical form which contains two rotors, the inner one of which is keyed to the driving shaft. The outer rotor has four ports which are open to both the suction chamber and the discharge chamber during rotation. Cut-off between the suction and the discharge sides of the pump is accomplished by a lip at both the top and bottom of the pump body which closes the ports momentarily. The liquid is drawn into the pump through the ports of the outer rotor while the space between the internal and external gears is increasing in volume and forced out of the opposite side of the pump during the last half of the revolution when the pocket is decreasing. The rotors themselves are flat castings with the sides in parallel planes. The edges are cut in the form of circular arcs as shown in the illustration. The outer rotating member is a working fit in the body casting at its periphery but is free otherwise, the inner rotor imparting motion to it.

The pump is self-priming and is adapted for boiler feed, circulating, ballast or lubricating work and for handling oil, bilge water, gasoline and the like.

Progress of Shipping Legislation

ALTHOUGH a majority of both the House and the Senate will undoubtedly support the bills introduced for the purpose of repealing the Panama Canal tolls affecting American ships, it is known that President Harding believes that this object can be accomplished in a more satisfactory manner through diplomatic channels. In fact, the President has stated that such negotiations have already been started. Considerable opposition is expected to develop at the public hearings on these bills, particularly from the railroads as the steamship companies operating through the canal have already taken considerable business from them. Great Britain and other maritime countries are also expected to protest that such legislation is in violation of existing treaties.

The Senate has reached an agreement to take a final vote on Senator Borah's bill which provides for free tolls for American coastwise ships on October 10.

Senate bill (S. 2265) relating to a model marine insurance law for the District of Columbia, which it is hoped that the several states will copy, has been favorably reported by the Senate Committee on Commerce. This bill is practically identical with the one (H.R. 6775) now pending before the House. The importance of marine insurance to our shipping is discussed in an article appearing on page 663 of this issue.

In spite of the fact that the Administration and Congress have indicated that they favor private ownership and operation for shipping, a bill is now before the House Committee on Merchant Marine and Fisheries which would place the Panama Railroad steamship operation and army transport vessels under the Shipping Board. In addition to this the Secretary of the Interior in a bill, the title of which reads: "A Bill to Provide for the Consolidation or Redistribution of the Powers and Duties of the Several Executive Departments of the Government of the United States Relating to the Territory of Alaska *and for Other Purposes*," has included a section directing the Shipping Board to transfer to the Secretary of the Interior the ships necessary to establish a steamship line between Alaska and the United States which is to be operated by the Department of the Interior.

Senator Frelinghuysen has introduced a bill in the Senate providing for the use of the Shipping Board's wooden ships for a pontoon bridge from Yonkers across the Hudson. It is understood that the President and the Secretary of War have no objection to using the wooden vessels for this purpose so long as the War Department has supervision of the construction. About fifty vessels will be needed for this purpose but no appropriation will be required of Congress. The construction is planned to permit the free passage of small craft but a draw will be built for the larger vessels. The bridge would be built by a private corporation and tolls would be charged.

Senator La Follette has introduced in the Senate a resolution (S. Res. 113) in place of (S. Res. 90) which he had previously introduced, authorizing and directing the Committee on Commerce to investigate the wage controversy between the Shipping Board and private shipowners and their employees and into the causes and the claims and contentions of the respective parties and their merits. This investigation is entirely superfluous at this time and it is only another means of attracting undesirable notoriety for our shipping.

The public hearings on Congressman Edmonds' bill to amend the Seamen's Act will be attended by a committee from the American Steamship Owners' Association. They will urge that the proposed amendment to the La Follette Act shall include the recommendations on the revision of our maritime laws presented by the committee headed by P. A. S. Franklin. This committee was appointed about two years ago but no action has been taken on its recommendations.

A bill authorizing the Secretary of the Navy to investigate and receive claims of contractors has been reported by the House Committee on Naval Affairs. Such matters as reimbursing contractors and sub-contractors for actual losses under fixed price contracts during the war when such losses have been caused by the action of the Government agencies may be filed with the Navy Department within 60 days after the approval of the bill. The bill also legalizes certain written promises of the Secretary of the Navy on the authority of which contractors have made expenditures.

Senator King has introduced a bill in the Senate providing for cessation of work on the major portion of the 1916 naval program. The bill would stop the construction of capital ships and convert two of the battle cruisers into aeroplane carriers. It would order the immediate construction of four new fleet submarines. In spite of the recommendations of high naval authorities all over the world there is a decided effort now being made to create the impression on the public mind that the aeroplane is superior to ships of the line. The recent bombing tests conducted by aeroplanes have done much to support this effort notwithstanding the fact that the same arguments apply to torpedoes and torpedo boats which failed to make battleships obsolete. Aircraft should be met with aircraft as torpedo boats were met by destroyers. A plane that must go a long distance with only one or two shots in its locker must look out for the faster plane equipped with machine guns.

Great Lakes Commerce Through Sault Ste. Marie Canals During July*

Articles	U. S. Canal	Canadian Canal	Total
East Bound			
Lumber, M. ft. B. M.	35,754	660	36,414
Flour, barrels	630,500	488,640	1,119,140
Wheat, bushels	6,377,308	1,500,769	7,878,077
Grain, other than wheat, bushels	6,730,926	4,108,100	10,839,026
Copper, short tons	1,753	.....	1,753
Iron Ore, short tons	4,356,760	.....	4,356,760
Pig Iron, short tons	.....	.....	.....
Stone, short tons	800	2,160	2,960
General Merchandise, short tons	8,408	4,062	12,470
Passengers, number	3,796	6,804	10,600
West Bound			
Coal, soft, short tons	2,469,430	17,560	2,486,990
Coal, hard, short tons	445,754	.....	445,754
Iron Ore, short tons	.....	.....	.....
Mfgd. Iron and Steel, short tons	4,011	639	4,650
Salt, short tons	5,165	508	5,673
Oil, short tons	52,012	.....	52,012
Stone, short tons	50,013	.....	50,013
General Merchandise, short tons	45,511	36,080	81,591
Passengers, number	3,849	7,691	11,540
Summary			
Vessel Passages, number	1,449	613	2,062
Registered Tonnage, net	4,503,414	460,730	4,964,144
Freight—			
East Bound, short tons	4,832,797	179,103	5,011,900
West Bound, short tons	3,071,896	54,787	3,126,683
Total Freight, short tons	7,904,693	233,890	8,138,583

*Compiled at St. Marys Falls Canal, Michigan, under the direction of Colonel E. M. Markham, Corps of Engineers, U. S. Army.

WILLIAM L. BULL, of Baltimore, Md., formerly general manager of the Baltimore Oceanic Steamship Company, has been appointed assistant to W. J. Love, vice-president of the Emergency Fleet Corporation.

Random Notes By An Old Seaman

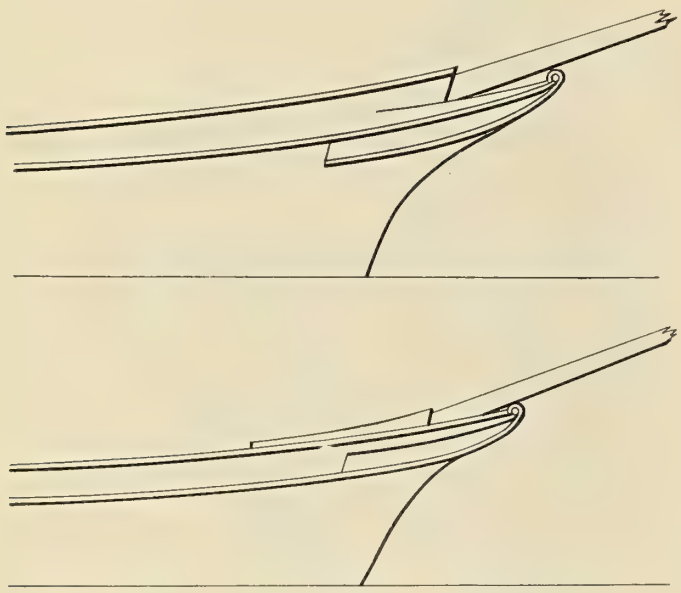
Why Beauty of Outline and Proportions Should Not be Disregarded in Naval Architecture

By Captain R. E. Barry

WE were once a race of seamen but now the mass of the people know little of the sea or shipping. Artists paint, and photographers produce by retouching, pictures of vessels which are a source of ridicule to the seaman. Prints and photographs of notably beautiful buildings may be found in most libraries and art stores, and colleges devote most of the time to the art end of architecture as distinct from the mathematical or engineering end, but how many beautiful vessels are known even by name?

Perhaps this lack of public sympathy has resulted in the idea that anything that will float and pay dividends is a satisfactory ship, but there seems no reason why grace and beauty should not be considered a factor in naval architecture. The worst offender in this line seems to be the Shipping Board which has designed some of the most hideous vessels afloat and has given names to the passenger vessels to suit their appearance.

Some of the west coast builders have turned out very fine looking tramps, but it is England and Germany that have designed the handsomest mail boats and sailing ships, and certainly Watson showed the world how to design steam



Figs. 1 and 2.—Watson Type Bows

yachts (see Figs. 1 and 2). Sir Edward Harlan spent much time over the profiles of the White Star steamers, and the *Olympic* carries a fourth and dummy funnel merely to balance the profile.

To the old sailor a few things are essential to beauty in ships. Fair curves, generally parabolic, certainly not straight lines running into circular arcs, an appearance of suitable buoyancy, with good sheer, the high bow balancing the broad stern and a balance of spars, funnel and houses that will not give a silhouette in imitation of the skyline of New York City will help much.

The old fashioned screw aperture which reached up to the tuck line is happily a thing of the past, but with some of the new type of rudders large gaps are left between the rudder and post and the effect of patch work is not pleasing. Filling plates are easily fitted, as was the custom in old days under the pintles of sailing ships.

Sheer

Denny and most of the foreign builders use a parabolic formula for the sheer, modified for the fullness of bow and crown of deck at the stern. The stem generally is given a rake forward of one in sixteen with a parabolic curve having a maximum offset of two to three inches one-third of the distance above waterline. Watson has produced the most beautiful clipper stems in which the knight heads are in a line tangent to the stem at the waterline.

A rather handsome flare has been given to the bows of most of the vessels built in the last few years, but the stem has often been straight and therefore has appeared hollow.

Very few good sterns have been built in the last few years. A slightly hollow counter is necessary to prevent the stern from looking fat. Generally, if the length of the counter and the part above the knuckle are about equal and the angular

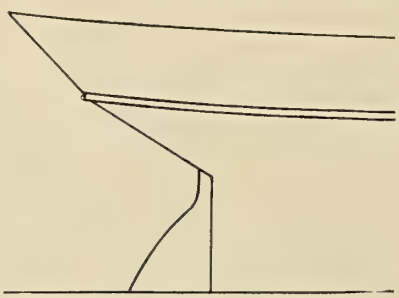


Fig. 3

change in direction not too great, the effect will be pleasing (see Fig. 3).

The half round at the knuckle is not artistic as it is not in the plane to suit the eye. Moldings as shown in the sketch will be effective and cost but little more. In one large vessel this work was fitted in wood, then taken down and used as patterns. Cast iron moldings were then fitted on the ship and calked.

Rudders

Where a rudder with integral stock is fitted it is much neater to fit the head of the stern frame with a cant forward, as in the sketch, than to fit the usual patch plate at the bottom of the rudder trunk for purposes of unshipping. If the sides of the transom are swung slightly aft, the periphery will come about in a vertical plane (see Fig. 5).

With the rudder separate from the stock some builders have made a vertical joint in the fore and aft plane which does not in any way mar the profile.

In large twin screw vessels the rudder could well be faired into the lines of the ship, the displacement increased with easier lines, and the facility for riveting about stern post increased (see Fig. 6).

One very pleasing feature of late designs is the elimination of the Lake type steamers with machinery in the stern. This class is suitable only for oil tankers or special types on very short runs in special trades. The master of the *Georgetown,* a lake built "stem winder," used to say that he could only try

for a soft spot on the beach, if caught light in an easterly blow.

OUTSIDE APPEARANCE

The outside of many steamers is made unsightly by streams of dirty water running down the side from the various scuppers. A few large cast steel scuppers discharging below the waterline would improve appearances, give heart to the mate

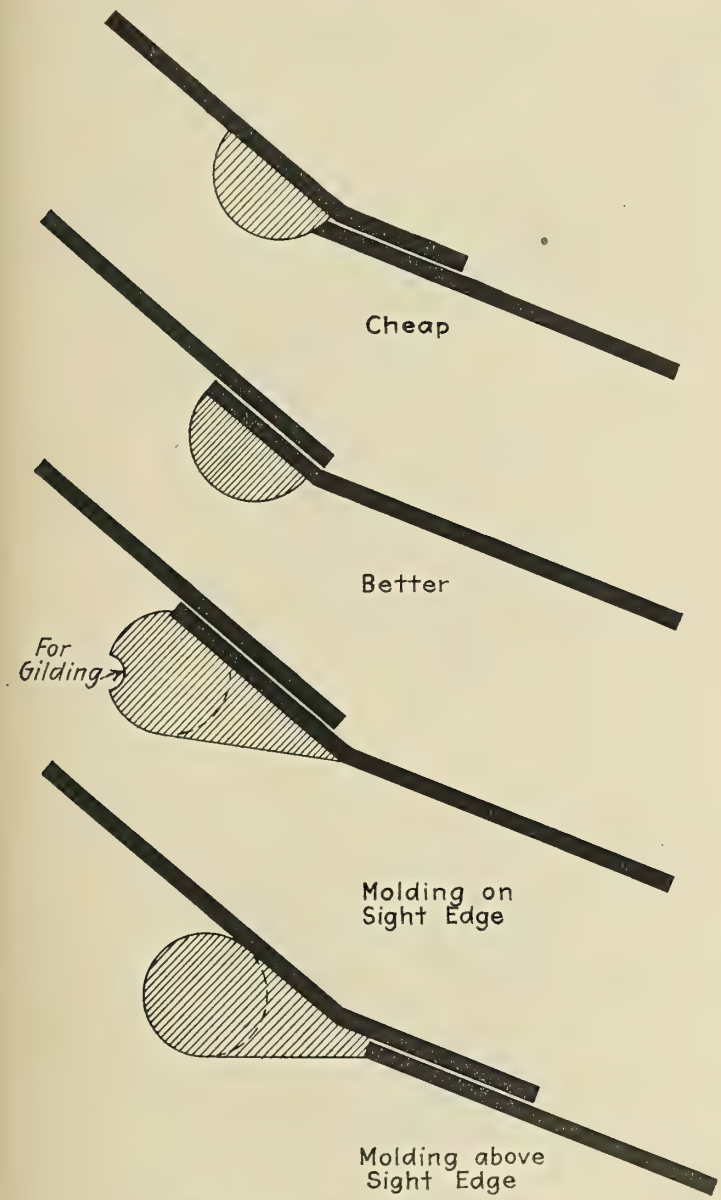


Fig. 4.—Moldings on Knuckles

and prevent loss of much time scaling and painting, probably enough in a year or so to pay for the longer scuppers.

Another thing which causes much annoyance is the exhausting of the anchor windlass engine to the atmosphere. On a cold day the steam often obscures the view from the bridge and the infernal noise prevents the mate on the forecastle head from hearing any order from the bridge.

The modern system of fitting the circulating discharge well above the load waterline has been the cause of much trouble and damage to cargo on docks, and a source of constant rows between the master and dock superintendent. The plates supposed to prevent the water getting on the dock are generally useless. While Lloyds advocate placing all discharges above the load waterline the suction is below and the factor of safety of a submerged discharge would be no less. Also some of the work done in elevating the circulating water is lost because the small engines of the circulating pumps are generally very inefficient.

Hinges on side ports were in the old days often a nuisance, causing a delay in docking, when the tide held a vessel to the corner of a dock and tugs could not breast the ship off. Also rims of port lights should not project as they will be broken or bent by docking. Again there is no need of any projections on the side of a ship for gangway grating, as

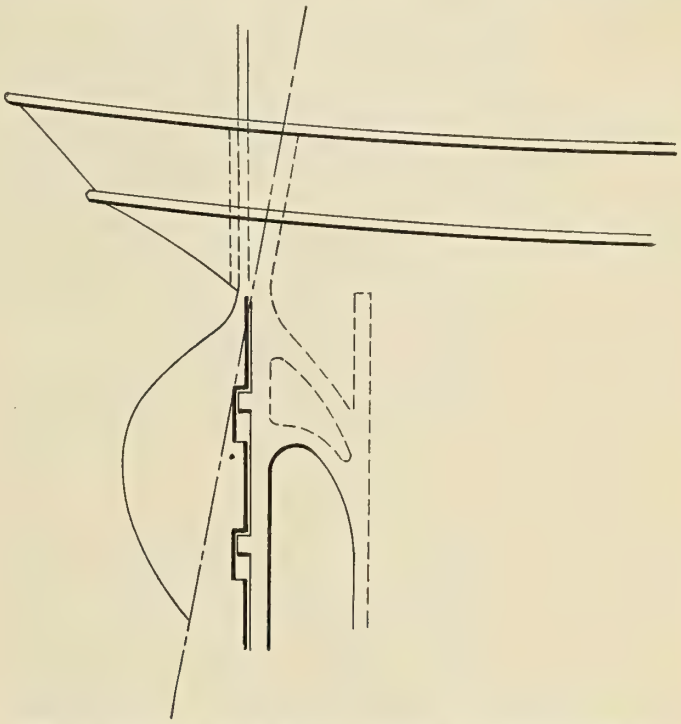


Fig. 5—Head of Stern Frame Canted so Rudder May Be Unshipped Without Large Hole in Shell

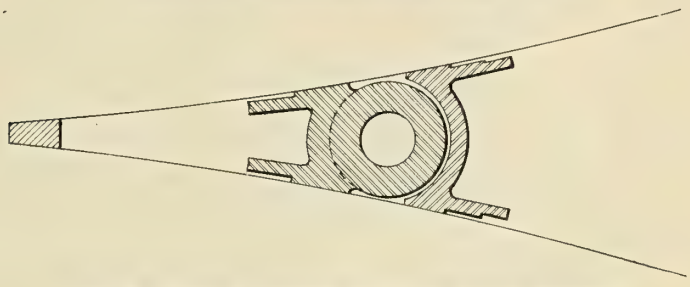


Fig. 6.—Type of Rudder for Twin Screw Steamer

hinges can well be fitted inside the sheer strake and the strut foot held by a chain span from the deck.

RAKE OF MASTS AND FUNNELS

In connection with sheer it is logical to rake the masts, otherwise the foremast will cant forward relative to the deck line and appear anxious to go over the bow.

If the foremast is aft of a normal to the line of sheer at its foot with a rake of at least half an inch to the foot and the other masts and funnels increase their rake by an eighth of an inch to the foot, a stiff gaunt appearance will be avoided. The Cunard, White Star and North German Lloyd steamers have a large rake to their spars and funnels and some of the Atlantic Transport vessels were also fine examples having four masts with increasing rake. The old *Egypt* of the National Line was probably one of the handsomest vessels in the Western Ocean trade. She had a flush deck, a stem raking slightly forward, four masts, one funnel and very few deck houses.

About fifteen years ago large cross trees came into vogue. Those responsible probably had their seagoing experience in

a stone quarry and thought that ship's booms ought to swing the same as derricks do at home. But swinging booms take two or three times as long to handle cargo as do two fixed booms. Also, if the ship listed, there would be trouble with the swinging boom. If the boom guys are properly fitted and led, there is no reason why the point of support of topping lift should be within ten or fifteen feet of a perpendicular through the heel of the boom, therefore the cross trees are useless and only a source of head wind resistance and weight. They certainly are an eyesore.

Booms

The large tables fitted to masts often seem to be used more for holding the lead blocks than to shorten the booms. In this case the required lead from the mast can be obtained by canting the winch, and it is often desirable so to cant them that leads can be made direct to the mooring pipes. I wish builders would fit guards to prevent the falls getting into gears due to the carelessness of longshoremen.

It seems a shame to fit the large number of derrick posts seen on some modern vessels as four masts can work eight hatches and, if required, work both sides in the stream.

The Pacific coast method of using the outboard fall as a runner on the inboard with one man handling both winches is an improvement of great merit. But on the coast the vessels carry their own winchmen.

Deck Houses

A generation ago while the influence of the sailing ship was strong in the design of steamers, the amount of deck house was limited to a chart house with bridge above, but since the bridge house has become a coal bunker and in the oil burners a cargo space, the quarters have been placed above, with the master's room above the quarters and the wheel and chart house above that, and the standard compass on top of the wheel house with a fence built around it. The resulting windage is large, especially in the smaller ships. One small steamer with erections only twenty feet fore and aft required about two hundred and fifty extra horsepower to drive the excess erections nine knots in a twenty mile breeze. The model of the *Mauretania* required an increase of twenty percent in power to drive the structure added to represent deck houses. Owners pay to test models and to get extra economical machinery and then waste the gain by excess windage. I would never stow booms on end, fit cross trees, or make funnels circular when an elliptical section would answer, or put uselessly high houses on a steamer with fuel costing what it does today. I appreciate the comfort of a high bridge but believe a compromise should be made, especially in the smaller boats.

The average seaman wants an open bridge from side to side with the wheel house set back some five feet. The man who wants to stand inside can do so, but an interrupted bridge is very awkward near land and merely limits the movements without any advantage.

In large modern steamers where there is a variegated skyline the erections can well be normal to the base line, but in small vessels the houses, ventilators and stanchions should follow the yachting rule and be made normal to a mean line between the sheer and the waterline.

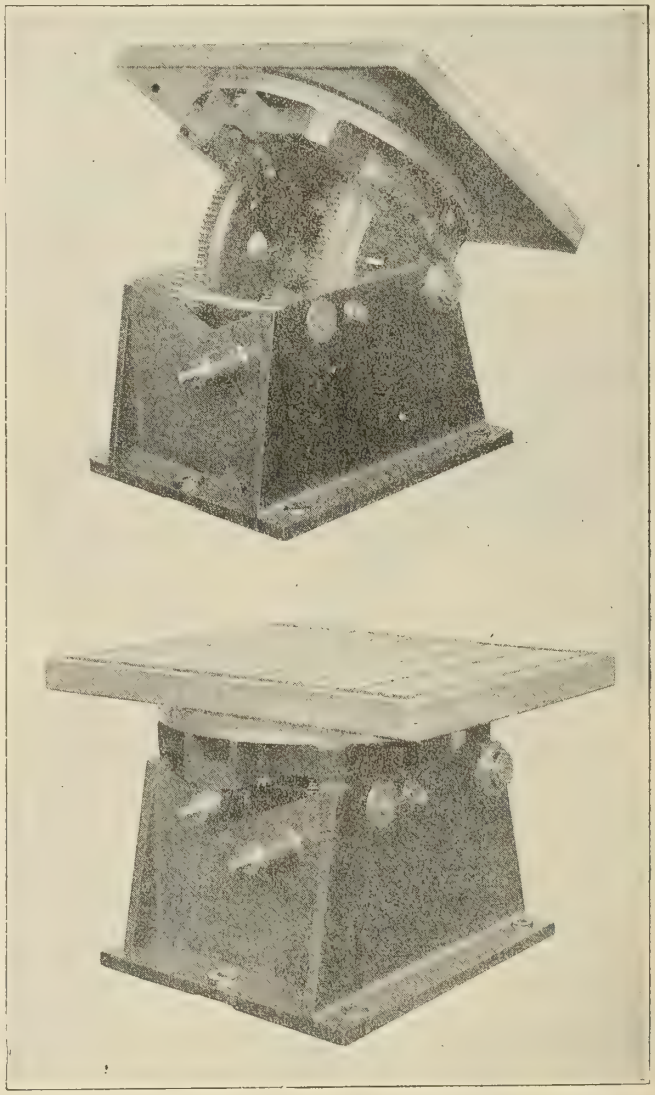
A type of house recently fitted above the bridge house is often set back six to ten inches from the side of the ship. This makes a scupper which is hard to clean and is a nuisance. Even if the old type of davits are fitted, they can be fitted inside a canvas watertight collar.

A neatly kept waterline is a great help to appearance, but where it is left to the crew to touch up, it gradually becomes out of line and blurred. The *Gascony* had a plate sight edge at the upper edge of the boot topping and thus saved time in painting both afloat and in drydock.

Crews' water closets have been a source of much trouble. A cast iron trough say twelve feet long with a roll rim should be fitted with six to ten inch discharge pipes or at least of sufficient size to pass a jumper or a whiskey bottle, and the water should never be shut off. The rim should roll in.

Tilting and Rotary Table for Use with Boring and Drilling Machines

As a means of speeding up work and reducing machine shop costs a new work table for use with floor type boring, drilling and milling machines, known as the Universal tilting and rotary table has recently been put on the market by the Pawling & Harnischfeger Company, Milwaukee, Wis. This accessory makes it possible to carry out machining operations on five sides of a piece and at any angle with but one set up. The table has an elevation of 90 degrees and can be revolved through 360 degrees in any position, flat or elevated.



Universal Tilting and Rotary Milling Table in Closed and Open Positions

There is a graduated dial placed in a convenient position so that the operator may locate the work accurately. The table top is elevated by means of two coarse pitch spur gear segments driven by means of a worm and pinions; and it is revolved independently by a bevel gear and pinion. One revolution of the ratchet handle turns the table 30 degrees and one revolution of the elevating handle elevates the top 2½ degrees.

The Selection of Propelling Machinery

Discussion of Factors Governing Choice of Most Suitable Machinery — Results Obtained With Various Types

By Professor Lawrence B. Chapman*

CONSIDERABLE difference of opinion exists today on the proper type of machinery to use for ship propulsion. The installation to give the most economical performance in service does not necessarily mean the one showing the lowest fuel consumption, for hand in hand with a study of fuel consumption must go a study of first cost, depreciation, cost of maintenance, space occupied, possibilities of breakdown and general feasibility of the installation as a whole. As an example, a case is on record where a quadruple expansion (land installation) showing excellent fuel consumption was replaced by another engine because of the high overall maintenance cost. Here is a case where the low fuel consumption was outweighed in actual practice by other considerations.

Another point that should not be overlooked is the interrelation of the efficiency of the power plant with the operating efficiency of the ship as a whole. Obviously, if the repairs or overhauling of a particular unit of a ship's power plant, or the ability to obtain a special kind of fuel, prolonged the ship's stay in port over that necessary for discharging and loading the cargo, it would be poor judgment to install such a unit or adopt the particular fuel, no matter what gain in fuel economy resulted. For a slow or medium speed cargo ship the fuel cost is not a large proportion of the total operating expenses; and hence a reduction in fuel consumption should not be accomplished at the expense of some more important factor in the operating charges.

The power plant and fuel have another relation to the ship as a whole, in that they both affect the cubic feet of cargo space, the tonnage measurement and the net deadweight capacity. A reduction in steam consumption is accompanied by a reduction in the size (and cost) of the boilers, piping and auxiliaries and bunkers which in turn increases the carrying capacity of the ship. So complex is the problem that no exact solution is possible—the best that can be done is to give proper weight to all the factors involved.

The tendency in the past has been too conservative in regard to innovations and improvements in a ship's power plant. There has been some justification for this, for if troubles arise with new types of machinery at sea, the engineer cannot call on the manufacturer for help and assistance, as in a land installation, but must make his own repairs and solve his own problems. Further, when a ship is at sea the superintending engineer does not have access to the plant as in a land installation and the chief engineer is thrown absolutely on his own resources. During the war marked advances were made in marine engineering; much of the conservatism has been swept aside and many things almost impossible a few years ago are today generally adopted. Still there is a great deal of conservatism left among shipowners as the failure to adopt Diesel engines bears witness.

Types of Propelling Machinery Available

In the selection of machinery for a merchant ship, we have the following types from which to choose:

1. Triple expansion reciprocating engines.
2. Quadruple expansion reciprocating engines.
3. Direct connected turbines.
4. Combination machinery—triple expansion engines and a low pressure turbine.
5. Geared turbines.
   Single reduction 1:5 to 1:10.
   Double reduction 1:25 to 1:35.
6. Electric drive.
7. Diesel engines
   (a) two or four cycle.
   (b) solid injection; air injection.
8. Diesel electric drive.
9. Still engine—combination steam and Diesel.

All of these types have virtues and defects and a selection cannot be made on a few points alone. Many comparisons of the above types have been published from time to time, and I will not attempt to go into a general comparison in detail by pointing out the merits and drawbacks of each.

Factors Influencing Selection

The important factors involved in a selection are:

1. Revolutions per minute and propeller efficiency.
2. Fuel consumption.
3. Weight and space occupied.
4. Capital charges, including maintenance, repairs and depreciation.
5. General reliability.

For a low speed cargo ship of moderate power, high propeller efficiency requires low revolutions per minute. With the exception of the direct connected turbine, all the types mentioned can be designed for revolutions from 80 to 130 per minute.

With direct connected turbines the high revolutions per minute necessary for good turbine efficiency, reasonable weight and size are detrimental to propeller efficiency; hence this type of machinery has practically disappeared from ship propulsion and will not be considered here.

Reciprocating Engines

The merits of the triple and quadruple expansion engine are well known and need receive no attention here. The quadruple expansion engine shows better economy than the triple expansion engine, but its first cost is greater and it requires a longer fore and aft space; thus, while there is a reduction in annual coal bills and a reduction in bunker and boiler space, there is a loss of cargo space on account of the longer engine room required and an increase in capital charges due to greater first cost of the engine. Unless the ship is of sufficient size and the voyage long enough to show a fair increase in annual profits due to reduction in fuel costs and bunker and boiler space as offset against increased capital charges and loss of cargo space due to length of engine, the quadruple expansion engine is not to be recommended. As a rule the four cylinder triple expansion engine is to be preferred in place of a quadruple expansion engine.

Combination machinery at one time offered great possibilities in reduced steam consumption and would no doubt have been widely adopted except for the introduction of the geared turbine. This type of machinery consists of a three screw arrangement with reciprocating engines on the wing shafts, exhausting to a low pressure turbine on the center shaft. The steam consumption of this arrangement is nearly as good as that of the geared turbine. This is due to the high efficiency of the reciprocating engine at high pressures and of the turbine at low pressures. The two noteworthy installations are the steamships *Otaki* and *Rochambeau*. The machinery requires a larger space than reciprocating engines, but it was found in the *Otaki* installation that the loss in

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cargo space was offset by the reduction in bunker and boiler space. There resulted a considerable net gain in revenue due to reduced coal consumption.

As already mentioned, the geared turbine has taken the field offered by combination machinery and it does not seem likely that the latter will be used in the future except in perhaps a few cases. In steam consumption, weight and space occupied the geared turbine and electric drives are about the same; they are much lower than corresponding figures for the reciprocating engine.

In view of the fact that the geared turbine and electric drive have so much in their favor over the reciprocating engine, we might ask why the latter should be considered at all. If steam and fuel consumption, weight and space were our only criterion, the reciprocating engine would receive little consideration today. The triple expansion engine, however, is an installation of proven reliability; repairs can generally be made in any part of the world and marine engineers are familiar with the unit. The geared turbine and electric drive, on the other hand, are new and in some respects untried installations. Repair bills and the time lost in overhauling these units when operated by inexperienced crews may more than offset the advantages of lower steam consumption and reduced machinery space.

The four cylinder triple expansion engine with the improvements in design such as were used in the last reciprocating engined ships of the United States Navy has much to recommend it for certain low powered cargo ships such as tramps, on account of the character of the engine room force often available and the possibilities of repairs in out-of-the-way ports. There is no doubt, however, that too many reciprocating steam engines are being installed today, especially with the advantages offered by the Diesel engine.

Geared Turbine vs. Electric Drive

From the foregoing it appears that the choice of a steam installation narrows down to the geared turbine and the electric drive. As already mentioned, these two types of machinery do not differ greatly from one another in steam consumption, weight and space occupied. Certainly, the small differences in these factors are not enough to have an influence in the selection of one or the other for a cargo ship. Both can reduce the propeller revolutions down to a reasonable value. The little difference existing is in favor of the geared turbine which can reduce the revolutions per minute down to as low a value as is desired while the lower limit for a motor of less than 3,000 horsepower is about 100 revolutions per minute.* The efficiency is also slightly in favor of the geared turbine, amounting to 95 percent for the double reduction gears against 91.5 percent for the combined efficiency of the generator and motor. However, there is a small loss due to windage in the reversing turbine of the geared installation which reduces the output of this installation. The net result is that the geared installation requires about 2 percent less shaft horsepower than electric drive.* To this should be added a slight possible gain in propeller efficiency, if lower revolutions per minute are adopted with the geared turbine.

Ease of control, reversing and economy at reduced speeds are greatly in favor of the electric drive. Also, due to the fact that the electric drive requires no reversing element, a higher initial steam temperature can be carried which allows greater possibilities in economy by using higher steam pressures and superheat.

The electric drive has been proven beyond all dispute to be the ideal machinery for naval vessels where ease of handling during maneuvering is essential and where good economy at cruising speeds is required. These merits, however, do not appear to be pertinent for merchant ships where continuous duty at full power and a minimum amount of maneuvering are involved. The claim has been put forward for the electric drive that it eliminates the shaft alley; but this is accomplished only by a reduction in cargo space caused by the motor compartment aft.

During the haste and rush of the war a number of geared installations fell down due to poor workmanship; others failed because of incorrect design due to a lack of experience. Perhaps the largest amount of trouble, and that which has caused such a lot of prejudice and hesitation about adopting geared turbines, has been due to the inefficient handling on shipboard by inexperienced crews.

Single vs. Double Reduction Gears

With the careful workmanship which is available today, extended experience in design and proper attention to the oiling system after installation, there should be little trouble experienced with this installation. Most of the merchant ships fitted with double reduction gears today are operating perfectly. A recent paper before the Institution of Naval Architects by H. B. Tostevin points out that during the war there were 556 sets of geared turbines in the British Navy, some having been in operation six years. Of these, three were removed for realinement, two were removed and "dressed up" because of noise and slight wearing, two others developed fractured teeth but were not removed. Surely this is a creditable record.

The ships of the British Navy just referred to are practically all fitted with single reduction gearing with reductions between 1:5 and 1:10, the propeller running at 200 to 400 revolutions per minute. While revolutions as high as this give good propeller efficiency with high speed naval vessels, they are not admissible for slow speed merchant ships. Hence double reduction gearing has been adopted in the merchant service.

The British battle cruiser *Hood,* which has just successfully completed her trials, is fitted with four sets of reduction gearing transmitting 36,000 shaft horsepower each.

"From the experience so far gained there is no reason to suppose that gearing should not have a long life, provided that a reasonable amount of care be exercised in running an installation that has successfully passed through its specific tests."—Tostevin (Institution of Naval Architects, 1920).

A fair comparison, however, shows that the geared turbine and electric drive are on a par in most respects and are by far the best choice for steam machinery. If the cost of the electric drive can be made the same as the geared installation probably both will be used in the future. The electric drive no doubt will find favor for some time in merchant ships on account of its reliability until more experience with geared ships overcomes the prejudice and hesitancy now existing. The electric drive in connection with the Diesel engine offers special advantages for small installations and will be taken up later in this article.

As already pointed out, the lower the revolutions of the propeller per minute, the better the efficiency of the propeller. For cargo ships of 10 and 11 knots with about 3,000 shaft horsepower, revolutions per minute of about 90 have been adopted with geared turbines. Revolutions lower than this are even more desirable, if suitable gearing can be secured and the propeller diameter does not become too excessive. We thus see that the introduction of the geared turbine offers low propeller revolutions coupled with light weight as well as low steam consumption. Passenger ships with higher speeds can secure good propeller efficiency with higher revolutions per minute, but even here the revolutions per minute should be kept as low as possible.

The ships of the British Navy are practically all single reduction of between 1:5 and 1:10, the propellers running at 200-350 revolutions per minute. All of the American

*Marine Engineering, December, 1919, page 817.

cargo ships are double reduction of 1:23 to 1:36, the propellers operating at 90-100 revolutions per minute.

Boilers

The next point to decide is the type of boiler to use. There are two types open for selection—the well known Scotch fire tube boiler, and the large tube watertube boiler similar to the Babcock & Wilcox and Foster types. The lighter express types of watertube boilers will not be considered here as they are unsuitable for the merchant service. On account of necessity of light weight they are used in all high speed naval vessels.

Both the Scotch and watertube boilers have merits and defects. The Scotch boiler has been almost universally used in the merchant service. All sea going engineers are familiar with it; firemen can easily be secured for operating it; repairs can be made in practically every port of the world; and it has a large water volume and consequently is not dangerous in the hands of an inexperienced crew. These comprise the merits of the Scotch boiler. Its defects and drawbacks are many.

It has a very poor circulation and steam must be raised slowly. As a result of the poor circulation unequal stresses are set up, often causing it to be in a leaky condition and necessitating frequent and expensive repairs. On account of the long time required to raise steam it is particularly bad on short runs, when it is frequently cooled down and heated up. Frequently the time required for cooling, cleaning or repairing and raising steam in a Scotch boiler decides the length of stay in port. Scotch boilers cannot be forced as can a watertube boiler and are apt to be short lived if an evaporation rate in service of much over 5 pounds per square foot of heating service is maintained. Unless the Scotch boiler is fitted with a waste heat superheater and air heaters in the uptakes or is fitted with retarders or given a good length of tube for the same purpose, its efficiency will be less than that of the watertube boiler. This is especially true if the boiler is operated on fuel oil at high rates of combustion.

The watertube boiler has many advantages over the Scotch boiler. It occupies less space, costs less for a boiler of equal capacity, the upkeep charges are lower, and it is much lighter. Further, the watertube boiler can be easily forced without any serious results; steam can be raised quickly and it can be quickly cooled for repairs. Thus a case will seldom arise where a ship's delay in port is influenced by the boilers. As higher steam pressures can be carried with a watertube boiler, this alone may often be enough to decide in favor of this type.

A case is on record where a Babcock & Wilcox boiler was blown down, a tube removed and steam raised again in two hours. In another case steam was raised to 200 pounds pressure from feed at 100 degrees F. in 15 minutes.

In an earlier paper, "The Fuel Problems for Steamships," further advantages of the watertube boiler were pointed out.

From the foregoing statements it would seem that the tradition of the merchant service, its general familiarity and ease of handling with an inexperienced crew are the only things which recommend the Scotch boiler. For the most efficient operation and reduced operating costs of both ship and machinery the watertube boiler should be more universally adopted.

The universal adoption and good service rendered by the watertube boiler in the United States and other navies should be a sufficient recommendation for its use in the merchant service. On account of the great saving and weight, it should be the only type considered for high powered passenger ships.

Space Occupied by Machinery

The adoption of improved types of machinery and consequent reduction in the machinery space may lead to a reduction in revenue, and possibly a loss, at a place entirely unlooked for, namely, in the port and canal dues which are charged against net tonnage. The existing rules for net tonnage measurement allow a reduction from the gross tonnage of 32 percent for the machinery space, provided the actual measurement of this space is above 13 and under 20 percent of the gross tonnage. If this space does not lie between these limits, the reduction is 1.75 times the actual space. With improved machinery and reduced space the percentage might come out 12 percent. In this case the rule allows 12 by 1.75 or 21 percent reduction instead of 32 percent.

Mr. A. T. Wall, who first directed attention to this fact in a paper before the Institution of Naval Architects in 1919, cites the following example: Ship 580 feet by 70 feet by 45 feet with a gross tonnage of 20,000 and fitted with reciprocating engines and Scotch boilers. The space occupied by engines and boilers works out at 14 percent, allowing a reduction from the gross tonnage of 32 percent, or 6,400 tons. With an allowance of 1,350 tons for crew space, the total reduction becomes 7,750 tons. This gives a net tonnage of 12,250 tons. If the same ship is fitted with turbine machinery and watertube boilers, the actual space is 10 percent, which allows a reduction of 10 by 1.75, or 17.5 percent, instead of 32 percent, as before. This results in a net tonnage of 15,150—an increase in net tonnage of 24 percent with an actual gain of only 5 percent in cargo space.

Thus the owner is required to pay tonnage dues on 2,900 additional tonnage by the adoption of more efficient machinery. While the present tonnage measurements are in force it appears that the reduction in space brought about by turbine engines and watertube boilers might result in a loss instead of a gain.

This again illustrates the point that I have previously mentioned—that there are many factors which involve the hull as well as the machinery installation and that a decision as to the most suitable power plant cannot be given until every influencing factor is given its proper weight.

The Diesel Engine

The superior economy of the Diesel engine over all other types of prime movers is very marked. The fuel consumption of this engine averages about 0.42 pound per shaft horsepower, while the very best performance with geared turbines and watertube boilers is about 0.90 pound per shaft horsepower per hour. With the adoption of high steam pressures, superheat, high vacuum and the most efficient, oil burning watertube boilers and geared turbines, together with the most careful attention to the economical operation of the whole power plant, the fuel consumption for a steamship might be reduced to 0.85 pound per shaft horsepower. A consumption as low as this, however, would be practically impossible to maintain for any length of time in service conditions at sea. The best that can be expected of the steam installation in service is probably about 1.00 pound per shaft horsepower per hour. The Diesel engine, however, can easily maintain a consumption of 0.42 pound per shaft horsepower day in and day out at sea. Hence we can conclude that the best steam installation will have a fuel consumption of between 2 and 2.5 times that of the Diesel engine. This is comparing the very best type of steam machinery with the Diesel engine. If we extend the comparison to coal burning ships fitted with reciprocating engines, the fuel used will run from 3 to 3.5 times that of the Diesel engine.

With the Diesel engine showing this very large reduction in fuel oil consumption, we would naturally expect to see it replacing steam machinery at a rapid rate in new ships; but this is not the case. The Diesel engine has now reached the stage in its development where shaft horsepowers of 2,500 to 3,000 are in successful operation. With twin screws, an installation of 6,000 shaft horsepower per ship is possible today. The revolutions of Diesel engines now in operation in cargo ships range from 85 to 130 per minute.

Comparison of Diesel With Steam Machinery

Diesel machinery has the disadvantage when compared with steam, in that it is considerably heavier and has a higher first cost. It has the advantage in that it occupies less space, requires a much less engine force to operate and, as already pointed out, has a fuel consumption of one-quarter to one-half of that of steam installations.

Unfair comparisons of Diesel and steam machinery have at times been published showing that the Diesel machinery is no heavier and costs no more per horsepower than steam. These comparisons, on closer examination, generally reveal the fact that a Diesel engine with 120 or more revolutions per minute is compared to a steam engine of 90 revolutions. All comparisons of cost and weight should, of course, be made at the same revolutions per minute.

If an actual comparison of ships is made and the operating expenses and profits calculated, the advantages of the motorship quickly offset the small disadvantages of higher first cost and greater weight per horsepower.

Why, then, is the Diesel engine not more widely adopted? The objections raised by vessel owners appear to be mostly imaginary—it is a new type of machinery still in a state of development and subject to breakdowns; repairs may be difficult to obtain for this new type of machinery, causing interrupted service and long delays in port with consequent loss in profits; Diesel machinery is easily mishandled in the hands of an inexperienced crew; there is a scarcity of operating engineers and, if the Diesel engine is widely adopted, ships may be held up for lack of a trained engine room force; breakdowns and various troubles are frequently reported, and oil cannot be secured in all ports.

Along with these objections we must bear in mind that men trained in steam engineering hesitate to give up a well known and reliable type of machinery for a new and (to them) precarious type; and that new types of machinery have always been slowly adopted on shipboard as the operating engineer must be his own repair man and the engineer cannot call on the manufacturer for advice and assistance as could be done at a power plant on shore. This last is a strong argument against the rapid adoption of the Diesel engine for ship propulsion and can only be overcome by providing well trained and competent operating engineers. Careful attention on the part of the engine builders to see that the crew is properly instructed regarding the operation of their engine, and informed of all troubles likely to occur, will go a long way to solving this problem.

The other objections can be thrown aside because the successful motorship is a demonstrated fact. Those who are competent to answer assure us that well trained Diesel engineers are available at all times.

The first large motorship appeared in 1912. Today, to give two illustrations, the East Asiatic Company has 15 motorships aggregating 150,000 tons deadweight in operation and 16 more under construction and the Glen Line has 10 motorships aggregating 110,000 tons deadweight in operation and eight more under construction. The latest addition to the Glen Line fleet, the *Glenogle,* has a length of 502 feet, a deadweight capacity of 14,000 tons and a gross tonnage of 9,150. The ship is fitted with twin screws and has a total horsepower of 6,400. This line has a number of ships similar to this under construction. One motorship of the Glen Line has already covered 170,000 miles without an involuntary stop. Many firms in Great Britain and on the continent are building up large fleets of motorships while practically none is being added to the American merchant marine.

The Field for the Motorship

The Diesel engine, on account of its small power and large weight per horsepower, cannot be adopted at present for high powered ships or fast passenger vessels. For the same reason it is also not suitable for naval vessels. For the cargo ship and small passenger liners the Diesel engine is the ideal installation. Its adoption will reduce the operating expenses on account of the reduced fuel costs and greatly increase the annual profits because of the greater carrying capacity brought about by the large reduction in fuel weight and space required for fuel bunkers. As pointed out in an earlier article the weight and space occupied by fuel is about 25 percent of that required for a coal burning and 40 percent of that for an oil burning steamship.

With a short voyage, long port detention or slow speed, the gain of the motorship over the steamship is not so pronounced on account of the small percentage that the fuel costs bear to the total operating expenses. The longer the voyage, the quicker the turn around, and the higher the speed, the more pronounced is the economy of the motorship over the steamship. It is the combination of reduced fuel costs, increased deadweight and reduced crew, coupled with quick turn arounds and large number of trips per year, that produces the large gain in profits.

When a Diesel engined ship runs into bad weather there is a falling off in speed and consequently a reduction in the revolutions per minute. This reduction in the revolutions of the engine produces a reduction in power. In a steamship a falling off in the revolutions per minute does not necessarily cause a reduction in power, consequently a motorship should be provided with a somewhat larger shaft horsepower than the steamship or provided with enough overload capacity at reduced revolutions to maintain the same shaft horsepower in bad weather.

Four vs. Two Cycle Diesel Engines

After the Diesel type of machinery has been decided upon the question remains whether to select a four cycle or two cycle type. The relative superiority of these two types is a much debated question today among Diesel engineers.

The two cycle engine is a far more attractive proposition on paper than the four cycle but on the other hand is not so well known nor so universally used as the four cycle. It appears that the real question is not so much a comparison or selection of cycle as of make of engine. The two cycle engine is more difficult to design and is not so well understood and there have been more frequent breakdowns and troubles with this engine than with the four cycle. Hence those arguing for the four cycle engine have laid all these misfortunes at the door of the two cycle in general instead of the manufacturer in particular. There are some builders of two cycle engines who have had very good success with two cycle engines and apparently made good most of the claims put forward for this type.

Most of the attractions of the two cycle engine are not important enough to warrant the installation of this type in a cargo ship if there is more probability of trouble than with a four cycle engine. The loss of one trip per year or increased port detention due to frequent repairs will quickly offset all the small gains brought about by more economical machinery.

Many of the features of the two cycle engine are advantageous for passenger ships and ships where weight of machinery is an important item. No doubt the two cycle engine of the port scavenging type is destined to have a large field in the future, especially after further development and experience.

The advantages claimed for the two cycle engine are:

1. Weight 60-65 percent of four cycle at same revolutions per minute (hence reduced cost).
2. Space 55-80 percent of four cycle.
3. With port scavenging, less complicated head casting and simpler valve gear.
4. More uniform turning moment; reduced vibrations.

The disadvantages are:

1. Higher fuel consumption (5-10 percent).
2. Higher lubricating oil consumption.

3. Lower mean effective pressure.
4. Special means of cooling required on account of great heat effects.
5. On account of heat, at high speeds, piston cooling must be adopted.

DIESEL-ELECTRIC DRIVE

The Diesel-electric drive has been frequently proposed and to some extent actually fitted. The merits of this type of machinery are that one or more high speed Diesel engines, driving electric generators, can be installed and the ship propelled by an electric motor of low revolutions per minute and hence high propeller efficiency obtained without reducing the engine revolutions.

Most of the claims brought forward for the electric drive with steam machinery apply equally well to this type of installation and as already pointed out offer no particular attractions for cargo ships.

For the electric drive the first cost will be higher than for direct Diesel drive; the saving in weight will be small; and the installation will be much more complicated. Certainly little gain in economy or propeller efficiency can be claimed; and the direct connected Diesels of low revolutions per minute will be more reliable in service than the high speed generating sets.

The Diesel electric drive, however, does offer many advantages for naval vessels, yachts and fishing vessels where easy control and high economy at reduced speed are important factors.

THE STILL ENGINE

The Still engine is fitted with a double acting cylinder with the Diesel cycle on one side of the piston and the steam cycle on the other. The object of this combined steam and Diesel engine is to use the heat of the exhaust and cooling water in producing steam and thus increase the efficiency.

An efficiency 20 percent better than that of the Diesel engine is claimed for this prime mover. The engine has many interesting and valuable features. Theoretically it is an ideal and most efficient prime mover. Whether the complications of fitting a steam boiler and piping in combination with a Diesel engine will be feasible in practice remains to be seen. As an offset to the complications of the steam equipment the engine requires no circulating, air starting, or piston cooling system.

Comparative trials with a Still engine and a Diesel engine of 200 horsepower have recently been reported (Institution of Naval Architects, 1920) showing a reduction in fuel consumption of only 5 percent. This is rather disappointing, but future trials and experience with the Still engine may show much better results.

New Molding Material Eliminates Blow Holes in Thermit Welding

A NEW grade of molding material for Thermit welding, designed as "Thermit Molding Material," has recently been developed by the Metal & Thermit Corporation, New York, which, as proved by extensive researches and practical experiments, when used in accordance with the regular Thermit practice, will definitely prevent blow holes and assure sound welds.

The design of the new molding material is based on the theory that good silica sand will stand the heat of the Thermit reaction very well and that the weakness in all molding material is the clay binder. Therefore there should be as little clay as possible in the mixture, in order to make the mold more refractory and to increase its porosity. It is logical, therefore, that the use of a plastic clay has been selected instead of a fire clay, as formerly. The sand and plastic clay are ground together in a foundry pan or Moller, with the intention of coating each grain of sand with a minimum thickness of clay. This has resulted in a clean molding material, which should be rammed hard in the mold, which will stand up well under the preheating flame and which is extremely porous to the gases generated in the mold, resulting in a sound weld with a very clean exterior. Although suitable molding material can be made by increasing the clay content slightly and mixing the clay and sand thoroughly by hand, it is not so good as that made with a smaller clay content in the foundry pan or Moller.

The mixture now being used is composed of the following: 3 parts clean, sharp silica sand (100 percent of which should pass through a screen having a .03 inch square opening, and 40 percent of which should be retained on a screen having a .012 inch square opening) mixed with 1 part Welsh Mountain plastic clay. These parts are first thoroughly mixed in the Moller together with one-fortieth part glutrin by volume and sufficient water (one-twelfth part) to bring to the proper consistency. If mixed by hand, the sand and clay must be dried before mixing (being careful not to subject the clay to a temperature higher than 400 degrees Fahrenheit) and thoroughly mixed before adding the glutrin and water. The glutrin should be mixed with the water before adding to the sand and clay.

In the production of sound welds it is absolutely essential to be sure that no loose sand exists in the mold when the Thermit steel is poured. This is why very hard ramming is advocated, also why it is most important to blow out loose material from the interior of the mold by putting the preheating burner in the riser before the heating gate is plugged and being sure that no sand is detached by the operation of inserting this heating gate. The burner should be removed from the riser before plugging the heating gate, because otherwise it may detach some sand, which could not be blown out after the plug is in place. The heating gate plug should be thoroughly dry; and, if it has been carried in stock for some time, it should be warmed before using.

By perforating the sides and bottom of the mold box, the escape of the gases which pass through the molding material is greatly facilitated. Three-eighths inch diameter holes, spaced 3 or 4 inches apart, are sufficient. To facilitate the escape of gas from the bottom of the mold box, the mold should rest on blocks, not directly upon the foundry floor. As unnecessary molding material simply increases the resistance to the passage of gas, the mold box should be made as small as possible commensurate with safety. For example, in welding a 4-inch by 4-inch section, only about 4 inches of sand is necessary at all points, except, perhaps, on the pouring gate side. It is most important thoroughly to vent the mold box by forcing a rod or wire down at a number of points to within ½ inch or so of the collar. Care should be taken that these do not touch the collar because such vent holes will fill with steel and will therefore not facilitate the escape of gas.

LAUNCH OF S. S. YSSELDYK.—The steel cargo steamer *Ysseldyk* was recently launched at the Werf Gusto, Firma A. F. Smulders, Schiedam, Holland, for Messrs. Solleveld, van der Heer & T. H. van Hattum's Steamship Company, Rotterdam. The vessel is of the shelter deck type with a cargo carrying capacity of about 6,500 tons deadweight. The length between perpendiculars is 359 feet 3 inches, the breadth 50 feet and the molded depth 24 feet 6 inches. Propulsion is by a triple expansion condensing engine of about 1,800 indicated horsepower, supplied with steam by three single ended Scotch boilers of about 5,450 square feet heating surface working at a pressure of 180 pounds per square inch. The designed speed is 10 knots. The vessel is supplied with the necessary steam auxiliaries and is lighted throughout with electricity.

Modern Methods of Casting Propellers*

Molding Process Developed by George H. Thacher & Company Produces Propellers in as Many Hours as Old Method Took Days

THOSE acquainted with the marine field are aware of the remarkable developments of late years in the scientific study of the screw propeller, which enable the engineer of the present day to design a propeller wheel that will satisfactorily meet all specification requirements provided the finished wheel complies in all details with the design laid down. The propeller troubles of today, therefore, are chiefly of a practical nature in producing a perfect casting and many failures may be attributed to this cause.

General Methods of Propeller Manufacture

There are two general methods of manufacturing propeller wheels which are known as the sweep method and the pattern method.

In the sweep method the bottom half mold or nowel for each blade is swept up by a spindle, beam and pitch race and the cope or top half mold for each blade is built up individually on the nowel.

The pattern method is similar except that in place of the pitch race and sweep a blade pattern with the hub or a portion of the hub is mounted on a spindle and the blade mold formed, after which the pattern is rotated on the spindle to the proper position for the next blade. A solid pattern is sometimes used with this method instead of a single blade and spindle.

Both green sand and loam molding have been practiced with the above methods and the castings produced by each have been considered rough castings from which the finished product is produced by machining the driving face of the blades, boring, facing and keyseating the hub and by chipping the back of each blade to suit the template and provide for static balance.

Aside from the fact that the above methods are not conducive to either perfection or economy it is known that corrosion will be greater because of the removal of the dense skin of the casting and the local strains set up by the pneumatic tool in chipping.

Thacher Process

The Thacher Propeller and Foundry Corporation of Albany, N. Y., has been engaged in the manufacture of marine castings for a number of years but it was not until the outbreak of the world war that it decided to specialize in the manufacture of propeller wheels. Since then it has developed what is known as the Thacher molding process for propeller wheels and blades, which represents a marked advance over previous practice for work of this kind.

By this method it is possible to cast propellers that will be accurate as to diameter, pitch, blade area and thickness and in perfect balance when taken from the mold, no machining of the blades being necessary other than polishing or buffing to remove roughness along the edges.

The new process lends itself to speed in production as well as economy and a solid propeller, that would require six weeks to produce by the old process, can be molded, poured and shipped in one week.

Such a marked saving in time, of course, will be invaluable when measured in terms of detention of a vessel in port for repairs, to say nothing of the less cost of a new propeller.

*From information furnished by the Thacher Propeller and Foundry Corporation and a paper to be presented at the fall meeting of the American Institute of Mining and Metallurgical Engineers, at Wilkes Barre, Pa., by Dr. Enrique Touceda.

Equipment for Molding Propellers

There are 13 pieces of equipment necessary for the molding of a propeller by this process which are as follows:

1. Base or assembly plate
2. Template or jig
3. Nowel pattern plate
4. Nowel pattern block
5. Nowel
6. Cope pattern block
7. Blade pattern
8. Cope container
9. Cope
10. Center plate
11. Center arbor
12. Arbor cap.
13. Pouring ring or basin

Base or Assembly Plate

The base plate is an iron casting permanently located on the foundry pouring floor, the top surface of which is machined to a true plane.

For small wheels the base plate is a single casting but for the larger sizes it is made in two or three parts.

A hole is drilled in the center of the plate by means of which the jig is located when drilling the holes for the flask assembly.

Template or Jig

The template, which is used for locating the assembly holes in the base plate, nowel pattern plate, cope container, nowels and copes, is made of cast iron, machine finished to a true surface and drilled with the greatest precision.

Nowel Pattern Plate

A heavy, machine finished plate, of similar form to the top of the nowel and with corresponding holes, is used as a base upon which the nowel pattern block is mounted. The chief function of the plate is to definitely locate the driving face of any blade, molded from the same pattern, relative to the plane of the top of the nowel.

Nowel Pattern Block

The nowel pattern block is mounted upon the nowel pattern plate. At the base the block corresponds in shape with the top of the nowel but a taper of about one inch per foot is given the sides and tip end to facilitate drawing. The hub end is set at an angle of 90 degrees or 120 degrees depending on whether the wheel is four bladed or three bladed. The block is built of ordinary pattern wood to approximately the required height and then the top surface is faced with mahogany or cherry and swept down by means of a spindle, beam and race to the true designed pitch.

Cope Pattern Block

The cope pattern block is erected upon the nowel pattern block to insure that the bottom face exactly matches the top face of the nowel block pattern. The hub end of the cope pattern block is also built to correspond with the hub end on the nowel pattern block.

The form of the blade and thickness is provided for by next fitting a complete blade pattern to the face of the cope block.

Nowel

The nowel or bottom half of each flask is rectangular in form except at the end near the hub which forms an angle of

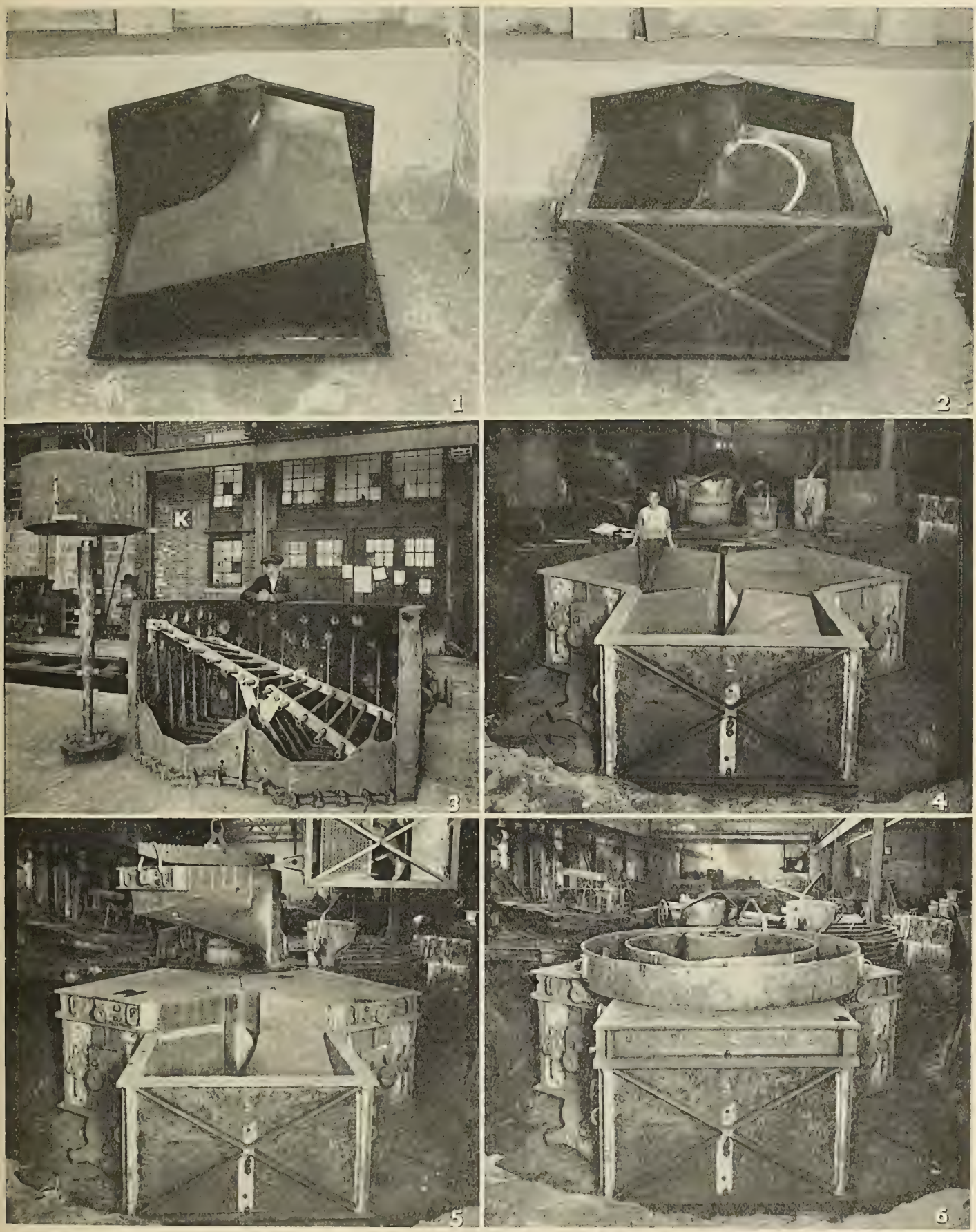


Fig. 1.—Standard Nowel Pattern Mounted on Nowel Plate. Fig. 2.—Standard Cope Pattern, with Blade Pattern in Place Mounted in Cope Container Ready for Molding. Fig. 3.—Nowel Flask Containing Adjustable Sand Reinforcing and Center Core Equipment. Fig. 4.—Three Nowels Assembled on Assembling Plate After Baking. Walking in the Mold Does Not Injure or Deface It. Fig. 5.—Placing the Copes in Position, the Blade Form, Pouring Gates and Dowels for Positioning the Arbor Cap Being Clearly Shown. Fig. 6.—Completely Assembled Flask Ready for Pouring

90 degrees or 120 degrees depending upon whether for a wheel of four or three blades. It is made of cast iron and the top end is open to permit fitting the pattern, the bottom having crossbars for strength and sand carrying. There are heavy flanges at the top and bottom which are machined in parallel planes and in which holes matching those in the cope and assembly plate have been drilled.

Sand carrying bars for stiffening the mold are fitted to both the nowel and the cope and these are adjustable to provide for variations in pitch and also for either right or left hand wheels.

Cope Container

The cope container is a receptacle used principally for ramming up the cope. It is made of cast iron with the sides and tip end tapered to suit the draft angle and the hub end angular similar to the nowel. Flanges at the top and bottom are machined in parallel planes and drilled to take a cast iron plate at the bottom, which supports and holds the pattern during ramming, and the cope at the top.

Inasmuch as the cope container is used for molding the cope, both the nowel and cope pattern blocks should be carefully made to fit it in regards to area, shape, etc.

Cope

The copes are shallower castings of similar general construction to the nowels. Heavy ribs are spaced at intervals and the top and bottom flanges are machined in parallel planes and drilled from the jig to match the nowel.

Center Core

A center arbor of hollow cast iron with turned ends carries the center core. It is held in position at the base by a

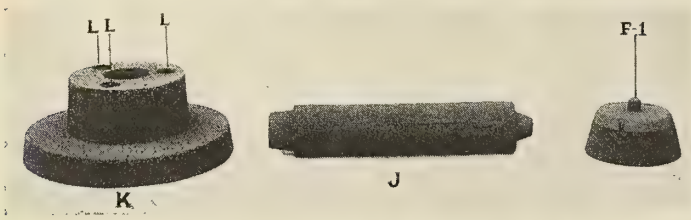


Fig. 7.—Center Core Made Up with Sand: F-1 Is the Center Plate, J the Center Arbor and K the Arbor Cap, with Holes L Used as Risers

cast iron center plate and at the top by an arbor cap or cast iron ring with a center held in position by brackets at the top. The cap is supported by lugs cast to the bottom of the ring which rest on the copes. Holes in the lugs fit over dowels in the copes and in this manner the cap is held in position. It is made up with sand, several holes through which provide for the risers.

Pouring Ring or Basin

The pouring ring is in the form of a circular cast iron trough with gates to each blade. The metal flows through each blade to the hub and rises through the hub riser until sufficient head is established to provide solidity.

Description of Molding Operations

The nowel pattern plate with the pattern block is set on a substantial floor and the nowel is placed over the pattern on the plate and bolted to the plate through the template holes in both. It should be remembered that the face of the pattern plate and both top and bottom flanges of the nowel are accurately machine finished in parallel planes, so that with the nowel in position and bolted to the pattern plate the bearing flange face of the nowel is in perfect contact with the pattern plate. The pitch plane on the pattern is therefore definitely positioned inside of the nowel with relation to the plane of the contacting surfaces and the drilling therein.

A suitable, strong, dry sand facing is riddled on to cover the pattern block. A weaker dry sand mixture is then evenly rammed or tamped, as the sand is dropped in, until the nowel is full and butted off even with the cross ribs and flanges. For large wheels the mold is made of a combination of Milville gravel and sharp Albany sand and for the small ones a combination of fine sand and linseed oil at 20 to 1 is used. A machine finished dry plate is next bolted to the nowel bottom and the nowel and nowel plate rolled over and deposited on a core oven truck after which the nowel pattern plate is unbolted and drawn off, using guide pins. The nowel is then ready for baking.

The nowel pattern is replaced on the floor and the second nowel placed in position and bolted thereon.

The same operation is conducted in the molding of the copes. While the description indicates that the copes are molded after the nowels, the two operations would naturally proceed at the same time. In the case of a 9-foot, three blade, destroyer wheel, or similar wheels up to 12 feet in diameter, with both cope and nowel production as described, the average molding time would not exceed 5 to 6 hours.

The mold is baked from 16 to 18 hours in an ordinary core oven at temperatures from 360 degrees to 420 degrees Fahrenheit (182 degrees to 216 degrees Centigrade) after which it is given an ordinary coat of plumbago wash and is ready for assembling.

The process is also adaptable for molding machine use which further lessens production costs. Wheels having blades of substantial size have been completely molded on a combination jolt and roll over machine. While to date a roll over devise large enough to handle a 20 foot wheel has not been made, the construction of such a machine is in contemplation.

For individual blades the same practice applies, with equal economy in time, material and accuracy of production.

Assembling

The assembly plate is thoroughly cleaned and each successive baked nowel is placed and bolted in position, as fixed by the jig. The baked copes are successively placed on the nowels and similarly bolted; the center plate being lowered in place in the center hole of the assembly plate and the joints between the copes and the nowels closed through the top opening by the use of slurry or lead paste. The center arbor is entered into the center plate, the arbor cap set over the center arbor and the pouring ring set on the copes and made up. The mold is then ready to pour. The operation of assembling the mold requires about 3 hours.

Pouring

The mold is poured through gates near the tips of each blade, insuring uniformity of flow and metal distribution as well as casting solidity and clean metal. Pouring near the tips of the blades washes out any grit or dust which might be left in the mold and which rises through the hub, no other risers being provided. The casting is left in the mold about 24 hours to avoid any danger of internal strains. The equipment is ready for the production of the next wheel as soon as the sand is shaken out of the cope and nowel. This sand, when cooled and wet down, can be used again on top of a new facing of sufficient depth to cover properly the pattern blocks.

Standardization of Equipment

For wheels built integral and for commercial use, the equipment is built in three standard sizes, 12 feet, 16 feet and 20 feet in diameter. Each unit is designed for either three- or four-blade wheels. For built up wheels the same standards are maintained.

Pattern-block Standardization

The patterns are standardized in diameter to suit the equipment diameter capacity, and in pitch to standard prac-

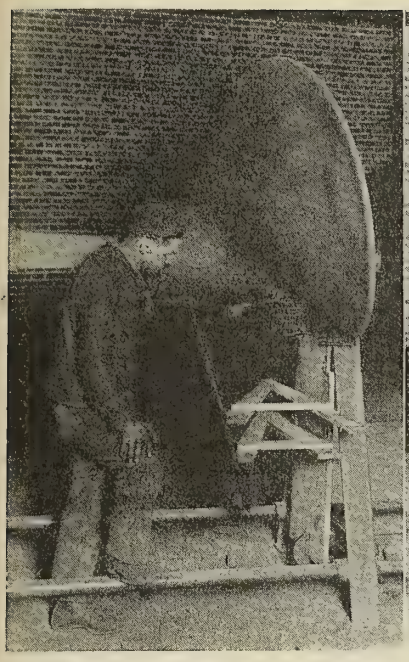


Fig. 8.—Testing for Patch

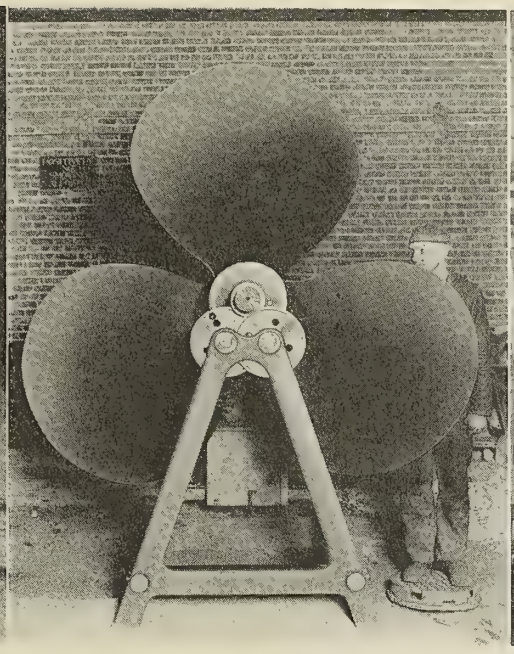


Fig. 9.—Testing for Balance

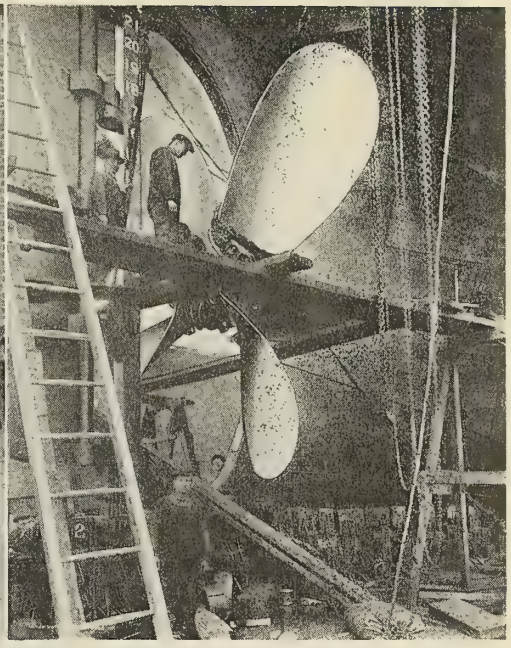


Fig. 10.—Installation of Finished Propeller

tice. For example, the patterns for the 16-foot equipment would be of sufficient length to fit the container of diameter capacity from 12 to 16 feet. The pitches on the pattern blocks are standardized for, say, 6-inch pitch variation and the required pattern blocks for the 16-foot equipment would be 14 feet 0 inches, 14 feet 6 inches, 15 feet 0 inches, 15 feet 6 inches, 16 feet 0 inches, 16 feet 6 inches, 17 feet 0 inches, 17 feet 6 inches and 18 feet pitch; or nine pitch blocks only are required to manufacture wheels of any diameter from 12 to 16 feet and with any combination of standardized pitch.

Assuming that wheel diameters increase by 3-inch variations, 108 combinations of wheel diameter and pitch may be made from nine standard pitch blocks by simply changing the blade form and area on the pitch block. Thus, while the initial cost of one pattern block, including blade form, may exceed the cost of the ordinary blade and hub portion, the total pattern cost, by the use of this process, is ultimately greatly reduced.

Tests

Tests are conducted by mounting the wheel, by means of a balanced turned arbor in which are keyways, on a balancing stand. Keys are inserted on each side of the hub.

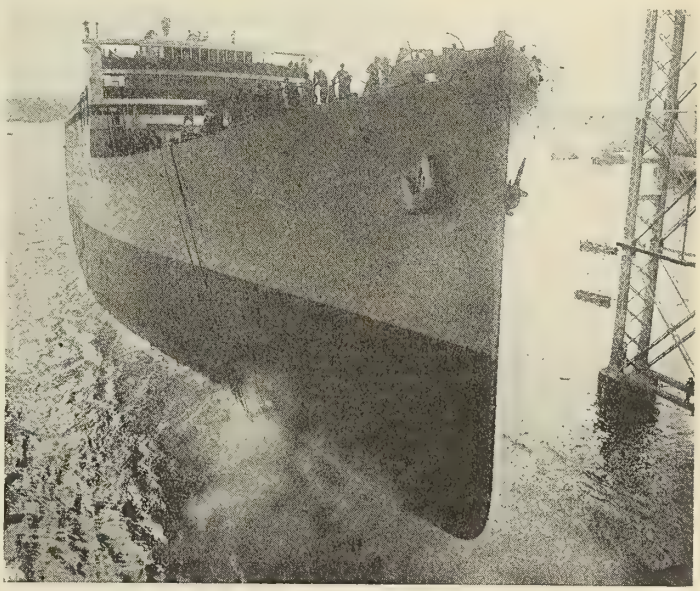
Through such tests the static balance of the wheel can be determined and by bringing a template into contact with similar sections of each blade the wheel can be tested for correctness in diameter, pitch, blade thickness and balance from an established center which, through this procedure, is accurately located for the subsequent boring to fit the propeller shaft.

By the Thacher process a perfect propeller wheel should result because the base plate is correctly machined, the positioning holes are located by template from the center and at the correct angle, and because the pitch plane in both nowel and cope patterns is transferred from the machine finished surfaces of the nowel pattern plate and cope container to a fixed position relative to the planes of the machine finished surfaces of each cope and nowel. When the machine finished surfaces of the cope and nowels are bolted together, the two pitch planes are in contact leaving an exact blade thickness or pattern reproduction in each blade mold. As the top flange in the nowel is machined parallel to the bottom flange of the nowel and the nowels are all of even height, it follows that when the nowels are bolted to the machine finished assembly plate the pitch planes are parallel with regard to the assembly plate and therefore in relation to each other.

Propellers cast by this process are bound to be exact duplicates in diameter, form and distribution of metal.

The above being true, the weights of similar wheels, when tested for balance and machined exactly alike at the hub, should also check closely. Tests have shown this to be the case and for large wheels—wheels of about 14 feet diameter weighing 11,600 pounds—the variation in weight has not been in excess of 10 or 15 pounds, while for small wheels of about 2 feet diameter and 90 pounds weight the variation doesn't exceed a few ounces.

The process further lends itself to economy in operation by virtue of the fact that the slip is reduced due to the accuracy of the casting and repairs and danger of breakdown reduced on account of the perfect balance.



Launching of the Peninsular State

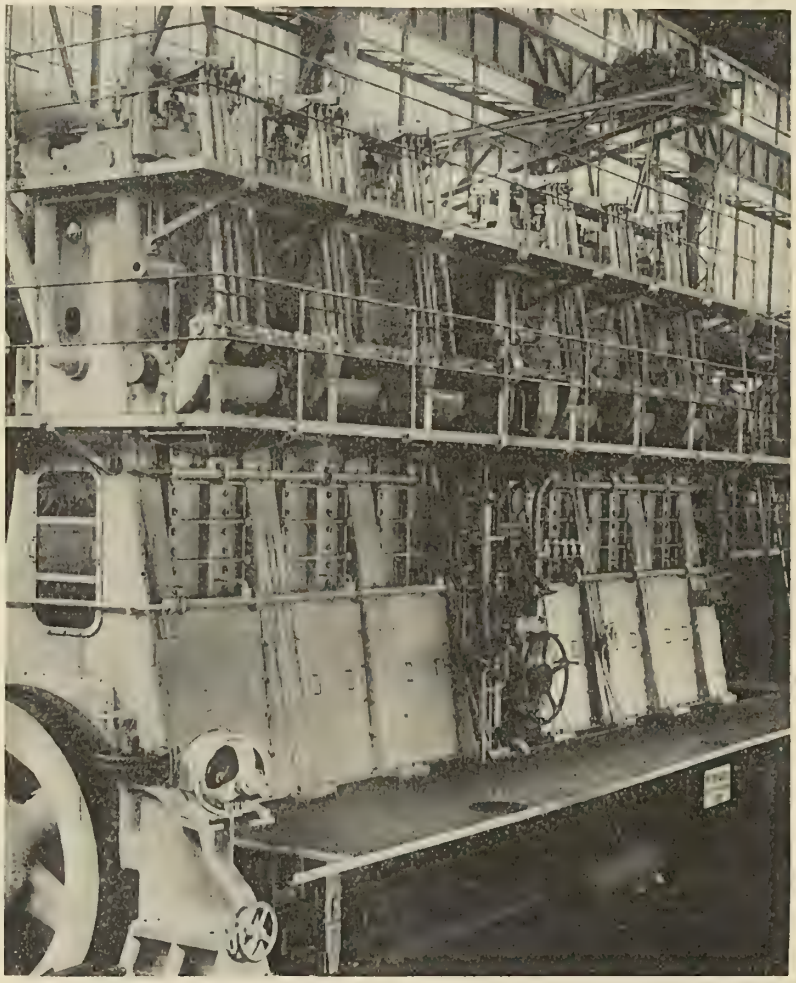
The S. S. Peninsula State was launched from the North Yard of the New York Shipbuilding Corporation, Camden, N. J., Wednesday afternoon, July 6, 1921. It was the last to be launched of a group of nine similarly designed 21,200-ton passenger liners under construction for the United States Shipping Board.

Innovations in Diesel Engine Construction

German Builders Introducing Novelties in Burmeister and Wain Design—Blohm and Voss Building New Double Acting Engine

By Our Special London Correspondent

THE fact that there are now just over 200 large motorships under construction in various yards in Europe, totaling more than 600,000 tons gross, is good evidence of the progress now being made with oil engine propulsion. Before the war the total tonnage of such vessels afloat was 234,000, a figure which has now increased to over 1,250,000. The slump in shipping has naturally put an end to orders for new tonnage, although this does not apply to Germany, where the greatest activity is being shown. British shipbuilders are somewhat perturbed at what is taking place in Germany for they see that, as a consequence of the majority of the German steamers being handed over to the Allies under the terms of peace, German shipowners are taking the opportunity to build up a new fleet of motorships, against which the old steamers purchased by various Allied shipowners will, in the future, have little chance to compete.



A 1,550 Indicated Horsepower A. E. G. Engine Built in Berlin to Burmeister & Wain's Designs

Among the orders recently placed in Germany are those for ten ships varying from 5,500 tons to 8,000 tons, all of which are being built at the new Deutsche Werft of Hamburg, many of them for the Hamburg-American Line, which has also placed orders with Blohm and Voss for some double acting engined ships. The Deutsche Werft is virtually part of a huge combination which includes the Gutehoffnungshutte and the A. E. G. of Berlin, the former works supplying most of the raw materials for the hulls, while the latter concern provides all the Diesel machinery.

Burmeister and Wain Engines Adopted in Germany

The engines, of which 20 are now being built for installation in the ten vessels, are of one standardized type, and are being manufactured under license from Burmeister and Wain. In order that production might be hastened, the drawings of Burmeister and Wain have been copied in practically every particular and those who are familiar with Burmeister and Wain machinery will at once see from the illustration that the A. E. G. engine is the same as the B. and W. type built in Denmark, Sweden, Norway, Great Britain and America. It is indeed a remarkable achievement for a Danish firm to have its design thus taken up in all the leading shipbuilding countries of the world.

The A. E. G. engine develops 1,550 indicated horsepower (one of the most popular of the Burmeister and Wain standards) and has the usual six cylinders 630 millimeters diameter and 960 millimeters stroke, the speed of revolution being 125 per minute. A novelty has been introduced by the A. E. G. designers which is worth noting and which appears to have some advantages. This concerns the method of reversing. On the left of the large handwheel seen in the illustration is a small hand lever which, when moved to the right or left (according to the direction of rotation required), operates a servo motor; this first lifts the push rods off the cams on the camshaft, then moves the camshaft until the push rods are above the astern cams and finally drops the push rods down on to the cams, thus setting the valve gear for astern rotation. The large handwheel is next given a partial rotation, admitting compressed air to the cylinders and allowing the engine to start. A further movement of the handwheel cuts air off three cylinders and brings them on to fuel, while a final rotation causes the remaining three cylinders to operate on oil. In the ordinary Burmeister and Wain engines this handwheel is not used, but in its place are two handlevers, one controlling each group of three cylinders. The latter arrangement gives a more independent control, but on the other hand the wheel is simpler to manipulate, and consequently would be likely to appeal strongly to a certain class of marine engineers who dislike complications.

Double Acting Engines

With regard to the other German motorships being built, these are to be fitted with Sulzer, Krupps and M. A. M. engines, in addition to a number of vessels in which Blohm and Voss will install their double acting motors. The very greatest secrecy prevails in connection with these sets, and it appears perfectly impossible to obtain any information concerning them. It is believed, however, that some double act-

ing engines are now in course of manufacture, larger than any internal combustion motors yet produced.

Blohm and Voss have brought out a new design, based on the experience gained with their first double acting engines, and it is not unlikely that some of the departures made will be quite revolutionary. It is well known that in a double acting engine one of the difficulties which the designer encounters is to obtain reasonable power at the bottom side of the piston, partly owing to the presence of the piston rod in the combustion space and partly owing to the difficulty of obtaining efficient combustion, since the piston rod is placed centrally. This has been overcome to a certain extent in the new Blohm and Voss engines by the adoption of double piston rods, with the fuel valve between them, while another innovation will probably be the employment of scavenging ports instead of valves, thus simplifying the design to a marked extent. In the existing double acting engine two scavenging valves, top and bottom, have been utilized on each cylinder so that there are more valves required than in a four cycle motor. Other improvements include a better lubricating oil system and a modified cylinder construction, but it is doubtful whether much more will be learned of these new engines until the first sets are put into operation.

Utilizing Oil Engine Exhaust Gases

One of the features of the latest Vickers engined motorships, the *Scottish Maiden,* which has just been launched and which is the fourth built during the past eighteen months, is that an attempt is made to recover some of the heat in the exhaust gases, the waste of which has always been a reproach to the internal combustion engineers. Many years ago the Werkspoor Company passed the exhaust gases around a boiler and raised steam for auxiliary purposes but, for some reason, the results were not as satisfactory as had been hoped. Vickers have now adopted a somewhat similar plan, and on the *Scottish Maiden* the exhaust from the two main engines is used to raise steam in a Bonecourt boiler, this steam being sufficient, it is thought, to run all the steam driven auxiliaries required when the vessel is at sea. This arrangement would not be applicable to most motorships where an electrical plant is utilized almost exclusively but on the Vickers vessels, which are tankers, steam auxiliaries are adopted. The experiment will be watched with some interest as shipowners are now anxious to economize in fuel to the last pound and, if a saving of only 5 percent can be obtained, the system is distinctly advantageous. Experiences alone will tell what practical difficulties, if any, may be encountered with this system.

13,500 Deadweight Ton Motorship Malaya

Twin Screw Vessel Equipped with Direct Reversible, Crosshead Type Diesel Engines Developing 4,500 Indicated Horsepower

ANOTHER example of the growing tendency to equip the largest freighters with Diesel motor propelling units is the motorship *Malaya,* the trials of which were conducted by the builders, Burmeister & Wain, Ltd., Copenhagen, on July 9 of this year.

The *Malaya* and a sister ship, the *Afrika,* were built for the East Asiatic Company, Ltd., Copenhagen, to engage in trade in the Far East.

Characteristics

The *Malaya* was built to Lloyd's rules, class 100 A 1-awning deck with freeboard, and has the following characteristics.

Length overall	464 feet 6 inches
Length between perpendiculars	445 feet 0 inches
Breadth, molded	60 feet 0 inches
Depth, to awning deck	42 feet 0 inches
Depth to upper deck	33 feet 3 inches
Depth to lower deck	23 feet 3 inches
Draft, loaded	32 feet 0 inches
Displacement	19,000 tons
Deadweight capacity	13,500 tons
Gross tonnage	9,050 register tons
Loading capacity, grain	700,000 cubic feet
Loading capacity, bales	640,000 cubic feet
Water ballast	1,664 tons
Bunker capacity	1,472 tons
Cruising radius	about 30,000 miles

Propelling Machinery

The propelling machinery consists of two six cylinder main motors of Burmeister and Wain's standard direct reversible, forced lubricated crosshead type. They have cyl-

Motorship Malaya on Trial Trip

inders 740 millimeters in diameter and 1,150 millimeters stroke. Each engine develops 2,250 indicated horsepower or about 1,750 brake horsepower and together will give the ship a speed of 12 knots when fully loaded.

The fuel consumption of the *Malaya* is estimated at 14 tons per 24 hours based on data recorded during the maiden voyage of its sister ship *Afrika*. On the trial trip the consumption was measured for a period of 4 hours, during which the engines developed an average of 4,585 indicated horsepower at a consumption of 135.3 grammes per indicated horsepower with common crude oil. This corresponds to

View of Engine Room from Upper Grating

a consumption of 14.8 tons per 24 hours. The fuel consumption in motorships, however, is always greater on trial trips than on the following voyages due to the fact that the machinery on a short trial does not become fully heated and therefore the economy will not be as great as during normal work at sea.

The main engines are cooled with fresh circulating water and a fresh water cooler. This arrangement eliminates the drawing of mud into the cooling system which often happens when deep draft motorships are navigating the shallow waters usually found in harbors and rivers.

Auxiliary Machinery

Electric auxiliary machinery is used throughout the vessel consisting of the following:

Three cooling water pumps direct connected to an electric motor.

Two sets of forced lubricating oil pumps, geared to electric motors, for circulating the lubricating oil.

Two sets of bilge, sanitary, fire pumps, built as plunger pumps and geared to an electric motor.

A rotating ballast pump, with a capacity of 150 tons per hour, driven by an electric motor.

One electrically driven rotating fuel oil pump for supplying the daily service tanks and trimming the oil.

For pumping up the maneuvering compressor with maneuvering air of 25 atmospheres pressure and as spare for the air pump for the main motors according to Lloyd's rules there is an electrically driven two-stage auxiliary compressor.

Electric Plant

The electric plant consists of three 66 kilowatt, 220 volt generators driven by auxiliary Diesel engines of 100 horsepower each. These supply the necessary current for operating the engine auxiliaries and deck machinery as well as lighting the ship. For the lighting system the current is transformed to 110 volts by means of a rotating transformer.

The refrigerating machinery for ship's use aboard the *Malaya* was furnished by A. S. Thomas Ths. Sabroe & Company, Aarhus.

An electric windlass was furnished by Clarke, Chapman & Company, and the electro hydraulic steering gear by John Hastie & Company.

The vessel is rigged with 4 masts and amply supplied with derricks for handling cargo, there being one derrick of 30 tons, one of 15 tons, twelve of 5 tons and eight of 2 tons capacity operated by 20 electric winches supplied by Almanna Svenska Elektriska Aktiebolaget, Vesteras.

Accommodations

Besides the accomodations for the crew, there are rooms for 12 passengers in the deckhouse below the bridge.

The crew is accommodated in rooms aft arranged for 2 men each.

Both passenger and crew's quarters are heated by steam generated in a small boiler with a heating surface of 100 square feet. This boiler also drives a small compressor which may be used for pumping up the air bottles of the ship in the case of the air being blown out during a stop of long duration.

Trials

During the trial trip several runs were executed over the measured mile and an average speed of 13.1 knots was obtained. The ship was light. Draft forward 7 feet 5 inches, aft 15 feet 9 inches, displacement 6,180 tons. The maneuvering from full speed ahead to full speed astern was carried out to the entire satisfaction of all those present. On board were besides the representatives of the Danish Government's ship inspection, representatives of the East Asiatic Company, Lloyd's Register of Shipping, as representatives of the Ocean Steam Ship Company, Ltd., Liverpool, the Honorable Mr. Cripps, Mr. Hobhouse, Mr. Martin and Superintending Engineer Mr. Freeman, and from the Rotterdamsche Lloyd, Superintending Engineer Mr. Weidenaar; as these two shipping companies have decided to add motorships fitted with Burmeister & Wain's Diesel engines to their fleet.

Starboard Side of Engine Room, Showing Refrigerating Machine and Maneuvering Compressor

The *Malaya* left Copenhagen on the 16th of July for her maiden voyage to the Far East.

Timbers and Lumber for Shipbuilding Purposes

By Horace Holden Thayer*

This is the fourth of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the various classes of workers who have to deal with these materials from the materials point of view.

MANY different kinds of woods are used for shipbuilding purposes throughout the world and only such of them as are available for and used for shipbuilding in this country will be here dealt with.

An extremely valuable study of woods grown in the United States has been made by the Forest Products Laboratory of the Forest Service of the U. S. Department of Agriculture, located at Madison, Wisconsin; and many of the specifications and standards which govern the identification, marketing, use and care of these woods are based directly on their work. Their publications are available to all those interested in the subject and are as interesting as they are valuable. The Forest Products Laboratory has had in hand for about three years the preparation of a "Handbook of Technical Information on Wood for the Use of Shipbuilders" and the writer has been advised that the manuscript was recently completed but publication has been delayed because of lack of publication funds resulting from curtailment in governmental expenditures. It would seem to the writer that the curtailment might more profitably be made elsewhere, particularly when it affects work practically completed.

Classification Society Requirements

Where a steel or wood vessel is classed the species and grade of all wood having any bearing on her strength or seaworthiness have to meet certain requirements of the classification society concerned, and where not classed these standards or some other good standards should be adopted. There are some woods that the classification societies will accept for the structural members of various kinds, and they have assigned to these woods of the proper grade such periods of life under the particular service, as experience has shown may be counted upon, with proper care in the construction and maintenance. Inferior woods may be accepted with a corresponding reduction in the length of the period for which the vessel is classed, but their use is poor policy and only leads to excessive expense for renewals at subsequent surveys.

The principal timber for wood hull construction on the eastern and gulf coasts is southern long leaf Yellow Pine, and on the Pacific Coast, Douglas Fir, which in the east is more often called Oregon Pine. White Oak is used in considerable quantities where available, particularly on the Great Lakes; and in the New England district use is made of the Beech, Yellow Birch, Rock Maple and Chestnut there available. Yellow Pine and Douglas Fir are classed as soft woods while the others are hardwoods.

Other woods are frequently met with in parts of the construction of wood ships and more frequently in their joinerwork, and in the joinerwork, decks and ceiling of steel ships; and some information regarding the more important of them will be given.

Grading

Timbers and lumber are graded and classified according to rules laid down by associations whose names indicate the woods dealt with. Those of most interest to the shipbuilders are as follows:

Southern Pine Association, with headquarters at New Orleans, La.

West Coast Lumbermen's Association, with headquarters at Seattle, Wash., and Portland, Ore.

Southern Cypress Manufacturers' Association, with headquarters at New Orleans, La.

National Hardwood Lumber Association, with headquarters at Chicago, Ill.

Yellow pine timbers and lumber for ship construction should conform to the following requirements:

(a) All timbers and planking to be of Select Structural grade, which is sometimes called Dense Merchantable. This conforms to a density requirement and also demands at least 85 percent of heart, girth measurement, measured anywhere in the length of the piece.
(b) All planking, calked decking and ceiling to be also specified "Square Edged," and all decking to be cut clear of the pith or center of the tree.
(c) All outside timbers and planking from the keel to the rail, including Poop, Bridge and Forecastle sides, and from the waterways of weather decks to the centerline of the ship, including hatch coamings and any deck girders, should also be specified to have one wide face of every piece all heart, free of wane, and to show on edges adjoining the heart face 85 percent of heart for the full length of the stick. Floors and frames should be all heart where the sizes necessary will permit.
(d) Sills, plates, studs, beams and other construction members of erections to be Select Structural.
(e) Tongue and Groove material for erections, including canvas covered decking, should preferably be "A" grade, but grade "B" will answer for a large amount of the less particular work. It should be kiln dried.
(f) Tongue and Groove material for hold bulkheads to be Select Structural and for bunkers to be No. 1 Common, both edge grain, kiln dried.

Douglas Fir timbers and lumber for ship construction should conform to the following requirements:

(a) All timbers and planking to conform to the density rule requirements.
(b) All timbers including hold ceiling, except floor and frame timbers, to be of Selected Common grade.
(c) All planking including that for calked bulkheads, shaft tunnels, Poop, Bridge and Forecastle ceiling, planksheers and rails to be No. 1 Ship Plank.
(d) All calked decking to be of the grade known as Ship Decking, vertical grain, and cut clear of the pith or center of the tree.
(e) Floor and frame timbers to be No. 1 Common or better, all heart where the sizes necessary will permit.
(f) Sills, plates, studs, beams and other construction members of erections to be Selected Common.
(g) Tongue and Groove material exposed to the weather to be Fir Finish of the grade known as No. 2 Clear and better, and should be kiln dried.
(h) Tongue and Groove material used for canvas covered decking and the inside ceiling of houses is preferably Fir Finish of the grade known as Selected Flat Grain, kiln dried.
(i) Tongue and Groove material for hold bulkheads and bunkers to be Selected Common, edge grain, kiln dried.

White Oak timbers for ship construction to be selected stock from the grade of construction oak timbers and should conform to the grading requirements of the National Hardwood Lumber Association, which has formulated detail specifications for a number of the special items for which White Oak is particularly desirable.

Cypress timbers for ship construction should where pos-

*Member of Rossell & Thayer, naval architects and marine engineers, Philadelphia, Pa.

sible be Heart Select Common as graded by the Southern Cypress Manufacturers' Association; tongue and groove material to be grade B or better, and mold material to be Select Common.

The hardwoods generally should conform to such grading of the National Hardwood Lumber Association as meets the needs of the particular service. General requirements are that they should be square or rectangular if hewn, well seasoned, straight and sound, and free from injurious shakes, worm holes, excessive sap, large or unsound knots and other injurious defects.

Density Requirements for Select Structural Yellow Pine

The density requirements for Select Structural Yellow Pine timbers are of particular interest because they are largely the result of a method devised by the U. S. Forest Service which was adopted by the Southern Pine Association in 1915 and also adopted and made a standard of the American Society for Testing Materials; and because the Forest Service has recommended the same requirements for Douglas Fir for shipbuilding purposes. The requirements as adopted by the Southern Pine Association are below quoted. Instructions are given as to how to measure the rings in cases where the pith or core of the tree is or is not present.

"Dense Southern Yellow Pine shall show on either end an average of at least six annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth and fifth inches of a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

"The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood."

It has been established by test that the density or dry weight of most woods has a direct bearing upon their strength, and that for Southern Yellow Pine the above quoted density rule together with the standard requirements as to defects ensure the obtaining of suitable timbers for ship construction even if they are cut from Cuban Pine, Short Leaf Pine or Loblolly Pine.

Density Requirements for Douglas Fir

The following somewhat similar density requirements were adopted in 1919 by the West Coast Lumbermen's Association. The methods of measuring the rings differ from those adopted by the Southern Pine Association.

"Dense Douglas Fir shall show on one end or the other an average of at least six annual rings per inch and at least one-third summer wood measured over three inches on a line located as described hereinafter. Coarse grained material, excluded by this rule, shall be acceptable provided that the amount of summer wood measured as described shall be at least one-half. Material in which the proportion of summer wood is not clearly discernible shall not be accepted."

"Any timber whose least dimension is less than five inches shall not show the pith (heart) on the inspection end; pieces whose least dimension is five inches or more, may contain the pith."

Apart from density specifications the grading is largely a question of the presence of knots, shakes, cross grain, wane and other defects; so that these defects are pretty well disposed of by the selection of the proper grade. There are therefore only two classes of defects which call for specific mention here.

One of these is wane, which is either bark on the corner of the piece as sawed for delivery to the purchaser, or the absence of the corner. It is evident that wane does not affect the quality of the wood and that it may be allowed on all pieces where the absence of the amount of the corner concerned would not be detrimental to the service of the timber when in place, or where that part of the piece would be cut away in the shaping and fitting of the timber. Such an allowance is a help to the producer and well worth noting in timber schedules that are at all difficult. The notes should state the amount of wane allowed or there should be sketches to show the finished timber in way of it.

The other class consists of defects of any nature which will work out when the timber is shaped, such as splits, shakes, large and loose knots, etc.; and the same action can be taken with regard to them. Examples of this are:

Beams where a considerable amount is cut away by the camber of the upper surface.
Clamp timbers that are adjacent to the ceiling.
Hold ceiling where against ceiling of less thickness.
Keelsons bevelled down to meet the ceiling.
Hatch coamings.
Hatch strongbacks, which have two corners cut off.
Stem, stem gripe, knightheads, frame timbers with considerable shape, and other timbers that require shaping.
The ends of all timbers that are scarfed or spliced.

Strength

A comparison of woods on the basis of their strength is not of much value to the naval architect, shipowner, or shipbuilder in the general course of events, but it becomes quite important when he finds it necessary or desirable to substitute another kind of wood for one which has been previously determined upon and the dimensions of which have been settled by experience, classification society approval, or other good standards. In such cases the following list, prepared by the U. S. Forest Service particularly for shipbuilding, is at least a good guide as to what may be allowed or required. The increase or decrease stated applies to one dimension only.

	Increase Percent	Decrease Percent
Live Oak	—	20
Hard Maple	—	20
White Oak	—	20
Red Oak	—	20
Beech	—	20
Birch	—	20
Elm	—	None
Red, Black and Cotton Gum	None	—
Douglas Fir	20	—
Tamarack or Hackmatack	20	—
Port Orford Cedar	20	—
Chestnut	25	—
Bald Cypress	25	—
Norway Pine	30	—
Alaska Cedar or west coast Yellow Cypress	30	—
White Pine	50	—
White, Red, Black and Sitka Spruce	50	—
White Cedar or Arborvitæ	80	—

In the preparation of this list the Forest Service gave the greatest consideration to those properties which indicate the ability to hold fastenings or prevent mashings, such as hardness and compression perpendicular to the grain, although the other mechanical properties were also considered.

With the usual shipbuilding woods the presence of sapwood is not a factor in the strength as long as it remains sound, for the Forest Service tests have proved it to be as strong as heartwood.

Length of Life

The best guides to the probable length of life of the various woods used in shipbuilding in this country, when incorporated into the structure of a vessel, are a table prepared by the U. S. Forest Service along the lines of the tables that may be found in the Wood Ship Rules of the various classification societies and the classification society tables. The figures of the Forest Service are chiefly comparative, being based on the assumption that the life of seasoned true white oak is 15 years wherever located in the vessel. Other woods are compared with white oak, taking their location into

Table of Comparative Life of Woods as Framing Timbers

	Floors 3/5 L. Amidships		Naval Timbers and First Futtocks		Second Futtocks		Third Futtocks		Top Timbers and Rail Stanchions		Note—The columns headed F. S. are Forest Service figures based upon the assumption of 15 years life for True White Oak. The columns headed Class. Soc. are the average of length of life assigned by 3 classification societies, unless otherwise noted.
	F. S.	Class. Soc.	F. S.	Class. Soc.	F. S.	Class. Soc.	F. S.	Class. Soc.	F. S.	Class. Soc.	
Seasoned True White, Burr and Post Oaks	15	11	15	11	15	11	15	11	15	11	Average of 2 of the 3 classification societies
Seasoned other White Oaks, includes Cow Oak, Overcup Oak, Swamp White Oak, Chinguapin Oak and others	15	8⅔	15	8	12	8	12	8	12	8	
Seasoned Red and Black Oaks, includes Red Oak, Yellow Oak, Pin Oak, Willow Oak, Black Jack, Spanish Oak, Texan Oak, Scarlet Oak, Turkey Oak, Water Oak, Laurel Oak and Shingle Oak	15	9	15	8	12	3	8	3	0	3	Listed by only 1 of the 3 classification societies
Seasoned Live Oak	15	12	15	12	15	12	15	12	15	12	
Seasoned Elm, includes Cork or Rock Elm, Slippery Elm and White Elm	12	8⅔	12	7	8	6⅔	0	6⅓	0	6⅓	Limited to Rock Elm by 1 of the 3 classification societies
Seasoned Hard Maple	15	8⅓	15	3⅔	12	3⅓	0	3	0	3	
Seasoned Birch, includes Sweet or Black Birch and Yellow Birch	15	8½	15	7½	12	7	8	6½	0	6½	Avge. of 2 of the 3 classification societies for Yellow Birch
Seasoned Beech	15	8⅔	15	5⅔	12	3⅓	0	3	0	3	
Seasoned Black Gum and Red Gum	12	8	12	7	8	6	0	5	0	5	Listed by only 1 of the 3 classification societies
Seasoned Chestnut	15	9	15	10	15	10	15	10	15	9	Listed by only 1 of the 3 classification societies
Dense Southern Yellow Pine, includes Longleaf, Shortleaf, Loblolly, Cuban and others, when dense	15	9	15	9⅔	15	9⅔	15	9⅓	15	9⅓	
Dense Douglas Fir	15	9	15	9	15	9	15	9	15	9	
Seasoned Bald Cypress	15	11	15	11	12	11	12	11	15	11	Listed by only 1 of the 3 classification societies
Seasoned Tamarack or Hackmatack	15	9⅔	15	10	15	10	15	10	15	10	
Norway Pine	15	8⅔	15	8⅔	8	8⅔	8	8⅔	8	8⅔	
White Pine	12	3⅔	12	3⅔	0	3⅔	0	5	12	5	
Bay Shore Spruce	..	10	..	10	..	10	..	9½	..	9½	Avge. of 2 of the 3 classification societies
Common Spruce, includes Red Spruce, White Spruce and Sitka Spruce	12	5½	12	5½	0	5½	0	5½	12	5½	Avge. of 2 of the 3 classification societies
Arborvitæ or White Cedar	12	7	12	7	8	7	8	7	12	7	Listed by only 1 of the 3 classification societies

account. As the framing of a wood vessel cannot be readily renewed and as it is the part where the substitution of local or other easily available woods assumes the greatest importance, a table has been prepared and is here presented to illustrate for that part of the construction the Forest Service figures as compared with the average of figures given by three classification societies, which show their comparatively recent or present practice. It will be evident from this table how important it is to use the proper wood and why woods which are abundantly strong cannot be used in certain locations.

Causes of Deterioration

Having arrived at some idea of the length of efficient service to be expected from any species of wood in any location on the vessel there are five main factors governing the life of the material actually used—the presence of sapwood, seasoning, preservative, ventilation and contact with woods of shorter life.

Decay is caused by fungi which dissolve the wood substance and use it for food; and they require a great deal of moisture in order to begin work, even with the so-called "dry rot," which requires less after it has developed.

Sapwood is liable to be destroyed by decay under conditions where heartwood remains sound; and if decay starts in the sapwood the heartwood is likely to be quickly affected also. For this reason the floors and framing of ceiled wood vessels and timbers in any location particularly favorable to decay should either be all heart or be thoroughly protected by the use of preservative. The Forest Service has made the following helpful recommendations regarding the use of sapwood:

1. As far as possible all trimming of timber at the shipyard should take place on the sapwood faces alone.
2. Where possible sapwood faces should be set so as to be always exposed to the air.
3. As far as possible all surfaces of timbers in contact should be free from sapwood.

The purpose of a preservative is to produce what organisms which cause decay might call denatured wood. The preservative is either a salt pickle or a creosote solution and will be dealt with in a separate paper. Their relative merits are pertinent only to the extent that these merits are dependent upon the nature of the wood to be used.

About the middle of 1918 one of the classification societies inaugurated the procedure of calling for the salting of wood vessels where the framing was of oak and the use of a creo-

sote preservative where the framing was of yellow pine or Douglas fir. This is probably because oak has naturally a higher moisture content than the other woods which renders it more easy to keep the oak pickled with brine, whereas the woods of low moisture content are more efficiently protected by creosoting.

Special attention to ventilation of vessels in service is particularly necessary at the ends of the holds, the framing of ceiled wood vessels, and other places that are always or generally closed in. Lack of proper ventilation leads to those moisture conditions that are favorable to decay and even seasoned timber will absorb this moisture. This applies to all species of wood, and explains the necessity for proper ventilation when a vessel is laid up.

Trouble from contact with woods of shorter life results from the fact that decay in the inferior wood will start decay in the other wood under conditions where the better species might have lasted for years without such decay. Examples of this are premature decay from the use of mixed framing and from the use of short-lived knees.

Seasoning

The principal value of seasoning is to guard against decay by reducing the moisture in the wood below the amount necessary for the life of the decay producing organisms. Furthermore green timber will not satisfactorily take a brush treatment of creosote preservative.

A glance at the headings of the table here presented will show that seasoning is definitely called for for most of the woods but that it is not so specified for the two principal woods used in wood ship construction, Southern Yellow Pine and Douglas Fir. This is because they contain less moisture to start with and because the soft woods season more rapidly than the hardwoods; so that Yellow Pine and Douglas Fir will season sufficiently as far as decay is concerned in the time required for all processes up to closing the timbers in. The sapwood of these species is, however, very wet and where present to any considerable amount necessitates the seasoning of the timber. Most softwoods have much more moisture in the sapwood than in the heartwood while the moisture in the hardwoods is fairly uniform throughout.

The following figures from Bulletin 556 of the Forest Service are of interest in a consideration of seasoning. The values are from tests of small clear pieces and are the average of the heartwood and sapwood for the species. They show the weight of water in the wood as a percentage of the oven-dry weight of the wood.

Percent of Moisture in the Green Wood

Chestnut	122	Western White Pine	58
Eastern Hemlock	105	Black Gum	55
Bald Cypress	87	White Cedar	55
Pitch Pine	85	Norway Pine	54
Red Oak	84	Sitka Spruce	53
Red Gum	81	Hackmatack (Tamarack)	52
California Eucalyptus	79	Port Orford Cedar	52
Eastern White Pine	74	Live Oak	50
Western Hemlock	71	Rock Elm	50
Loblolly Pine	70	Longleaf Pine	47
White Oak	68	Cuban Pine	47
Yellow Birch	68	White Spruce	46
Shortleaf Pine	64	White Ash (forest grown)	43
Yellow Poplar	64	Red Spruce	43
Beech	62	Black Locust	40
Black Birch	61	Western Red Cedar	39
Hard Maple	60	Douglas Fir (coast)	36
Shagbark Hickory	60		

Seasoning is also of value to allow of a slight swelling when placed in service and thus ensure tight joints and contrariwise it is of value to guard against subsequent shrinkage and open joints. Boards for watertight bulkheads and for joinerwork should invariably be kiln dried.

Shrinkage along the grain is generally inconsiderable. It is about three-fifths as much in the direction across the annual rings, or radially of the log as it is paralleling the annual rings or tangentially of the log, and therefore decking, planking, hold ceiling, etc., should where practicable be set edge-grain, or with the annual rings running as nearly parallel as possible to the calking edges. This is particularly important with material for watertight bulkheads. The volume shrinkage is a combination of the tangential and radial shrinkage, and figures for this for some of the woods are given under the head of Treenails.

Where the pith or center of the tree is present in pieces of small cross section like decking, warping and twisting during seasoning are almost certain to take place.

Painting the interior of a wood vessel with an oil paint plugs the pores of the wood and interferes with seasoning, though a proper preservative does not do this. Dry rot is almost certain to take place if the timber is green or partially dry when painted.

In view of the foregoing and for other reasons that will be readily apparent the Forest Service has made the following recommendations bearing upon the subject of seasoning and decay:

1. The timber for each ship should be cut as soon as possible and piled under cover in a manner that will allow each piece to be thoroughly ventilated until used.
2. Dense hardwoods, hard to dry, may be kiln-dried by any approved method.
3. Where dense hardwoods, hard to dry, are air-seasoned, the ends of the pieces should be painted with an approved paint.
4. No timber should be allowed to lie in contact with the soil.
5. It is preferable that timber should be laid edge-grain.
6. Material of small cross section, like decking, should be cut clear of the pith.
7. All ships should be thoroughly ventilated.
8. Interior hull-painting should be omitted.

Holding Power for Fastenings

The hardwoods naturally have greater holding power for fastenings than the softwoods, and the different species group themselves roughly about as listed under the head of strength. Tests made with spike fastenings indicate that beech is somewhat superior to white oak, while red oak, ash and elm are about on a par in this respect somewhat below white oak. The Forest Service estimates from tests made to date that for equivalent strength the fastenings in dense Douglas Fir should be about 12½ percent greater in diameter than in dense Yellow Pine or that a correspondingly greater number should be used.

Timber Schedule Sizes and Surfacing

Standard lengths for ordering timbers and much of the lumber are multiples of 2 feet and odd lengths are usually charged for as being the next even length above. This can be overcome with short lengths by ordering two or more as one stick or allowing the mill to furnish them in that way.

All thicknesses less than 1 inch are charged for as 1 inch.

Where the material is surfaced at the mill the gross size is charged for, and a proper allowance for this when not definitely standardized is ¼ inch for each face surfaced. The mills will sometimes accept schedules where the allowance is only ⅛ inch for each face surfaced, but this will mean that on most of the timbers and planking they will have to use larger sawed sizes than they are paid for. The standardized allowances for surfacing of tongued and grooved lumber may be obtained from the sketches of the various designs as published by the lumber associations.

Where unsurfaced items are furnished hewn they should run a full inch over the specified gross size and should be distinctly specified to be square edged and of uniform size throughout, unless cut to some special pattern or templet.

The use of templets or sketches will often be of great assistance to the mills in filling difficult schedules and where a log

is not straight the full benefit of the curve can thus be obtained. The advantage of such sketches in connection with defects has been previously mentioned.

All unnecessary surfacing should be avoided on the ground of the additional strength of the unsurfaced timbers and on the ground of economy; and for the latter reason timber schedules should not call for the surfacing of items whose surface will have to be afterwards shaped off at the shipyard. Examples of items which do not require surfacing are the frames of ceiled wood vessels, end framing, deadwoods, etc. Examples of items which require shaping are the stem, knightheads, apron, stern post, rudder blade timbers and rails.

(To be continued.)

Steamship Manulani Inaugurates New Service

Matson Navigation Company Freighter Arrives in Philadelphia With Cargo of Molasses, Sugar, and Pineapples Valued at $1,750,000

THE recent arrival of the S. S. *Manulani* of the Matson Navigation Company in Philadelphia has directed the attention of eastern shipping men to this progressive Pacific Coast Company. Starting in 1882, when Captain William Matson entered the Hawaiian trade with the 185-ton sailing ship, *Emma Claudina,* this company has grown until now, aside from its smaller coastwise vessels, it operates eleven large steamers with a total tonnage of approximately 150,000, which trade between San Francisco and the Hawaiian Islands and are now beginning to serve eastern ports through the Panama Canal.

The peculiar history and conditions of the Hawaiian Islands are one cause of the success of this company. Cast up from the bottom of the sea less than 800 years ago, this newest inhabited land produces but two crops, sugar cane and pineapple; but it produces these in great abundance. In 1920 the sugar crop amounted to 600,000 tons, while the pineapple crop aggregated 200,000 tons, a supply for the entire Pacific Coast.

In return, every article used by the 256,000 inhabitants of the islands, from lumber and fuel to automobiles and clothing, must be imported. And this carrying trade is handled almost exclusively by the Matson Navigation Company. The interchange of such commodities offers these vessels a great advantage; namely, a full cargo waiting at each end of a trip permitting a return voyage just as soon as one cargo can be unloaded and another taken on.

With so much freight to handle these vessels must run on a schedule as close as that of an express train. A full crew of stevedores waits on the dock for a ship to arrive, with warehouses and freight cars ready to receive the incoming cargo; and the new cargo is piled ready to load, as every hour's delay means a loss of several hundred dollars.

With such operation only the most efficient and reliable machinery must be used. In 1915 the Matson Company gave the Westinghouse Electric & Manufacturing Company the contract for the propelling equipment for their new passenger and freight steamer *Maui.* This vessel, the largest in the Pacific trade, made a number of runs before being commandeered by the Navy for war transport service. In the latter she operated under gruelling conditions for the period of the war and then resumed her trans-Pacific run.

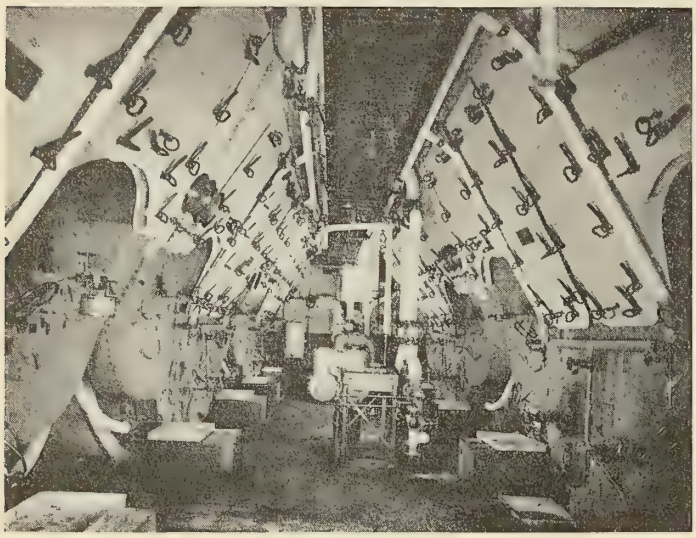
In all this her performance was so satisfactory that when the Matson Company, released from wartime restrictions, embarked on its new policy of expansion and let the contract for two of the finest and most modern freighters in the world, Westinghouse geared turbines were specified as the propelling equipment.

These vessels, the *Manulani* (Bird of Paradise) and *Manukai* (Bird of the Sea), which were built by the Moore Shipbuilding Company, Oakland, Cal., are 497 feet long. Each has a deadweight cargo capacity of 14,000 long tons, equivalent to the freight carried by 34 trains of 30 cars each.

New Matson Freighter Manulani on Her Trial Trip

Several unusual and interesting features are embodied in their construction. The engine room is located aft leaving the whole space forward clear for cargo. The hatches are unusually large and numerous which greatly facilitates cargo handling.

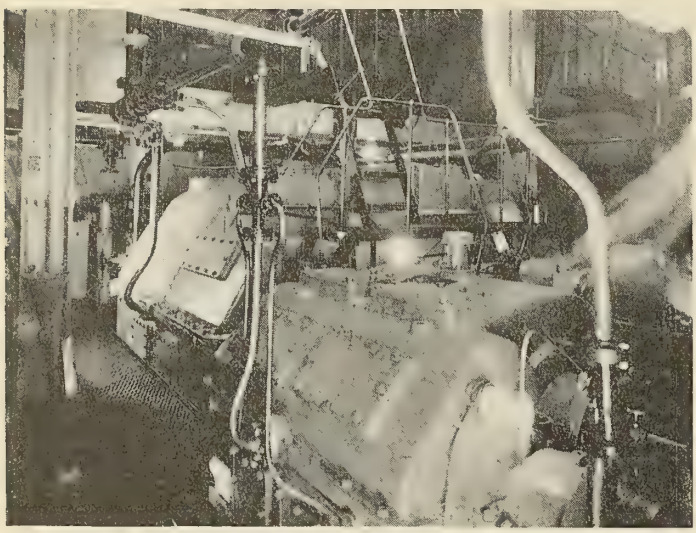
The double bottoms of the vessels form tanks in which fuel oil for the islands is carried on the outbound voyage.



Boiler Room

This is discharged at the islands, the tanks are rapidly cleaned by high pressure steam jets and are then refilled with molasses for the return voyage. The masts are hollow and extend down into these tanks, so that they act as relief pipes for the contents of the tanks, if expansion occurs or gas is given off.

On the return voyage, besides molasses, the vessels carry sugar and pineapples, the total value of one such cargo being



Engine Room

about $1,750,000. Special refrigerating and ventilating systems have been provided to preserve meats and fish, to keep the tropical fruit from sweating and to keep the sugar dry.

On her maiden voyage, the *Manulani* broke all Pacific records for freighters when she made the voyage in 6 days, 12 hours and 22 minutes, at an average speed of 13½ knots. Her designed full load speed is 12½ knots.

The machinery which drives each of these vessels consists of one set of Westinghouse 5,000-shaft horsepower divided flow turbines, which drive the propeller through a double reduction, floating frame gear. Each step of the reduction is in a separate case, the first reducing the turbine speed of 3,600 revolutions per minute to 460 revolutions per minute; and the second, the latter speed to 90 revolutions per minute.

A special feature of the turbines is the impeller type governor which automatically keeps the propeller from racing when the vessel is light or the screw comes out of water. It operates by means of oil under pressure, the pressure being maintained by a small centrifugal pump mounted on the turbine shaft. As this pressure varies directly with the turbine speed, a very sensitive and reliable governor is obtained.

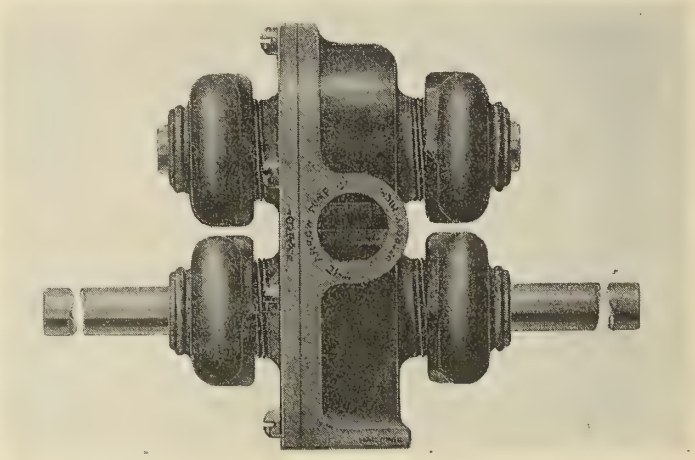
In addition to the propelling equipment, the Westinghouse Company also furnished the condensate pumps, ejectors, and the design for the condensers, which had to be specially adapted for using circulating water of high temperatures.

The average consumption of fuel per shaft horsepower hour on the *Manulani's* first round trip was less than a pound of oil, which is an excellent record for this class of vessel.

Rotary Geared Pump for Cooling Marine Engines

A NEW line of rotary geared pumps with self-lubricating packing glands for marine service has been designed by the Arrow Pump Company, Detroit, Mich. This type of gland construction is intended to reduce leakage and eliminate the possibility of scored shafts and worn bearings due to faulty lubrication.

The packing is located between the water being pumped and the bearings so that neither water nor foreign matter of



Arrow Geared Rotary Pump

any kind can enter the bearings. A film of oil is at all times maintained on the bearings, so that the shaft as well as the bearings are properly lubricated at all times. The glands are arranged in combination with an adjustment nut and an oil reservoir, to permit the use of a ring oiling device. In this way a constant supply of oil is fed to the glands, making it practical to use them as bearings.

The pump illustrated is arranged for a direct engine drive through gears, but pumps of similar construction can be fitted for belt and motor drive.

F. G. Friezer, formerly in charge of the export and import movements of freight for the Canadian-Pacific Railroad in New York, has been appointed as assistant to W. J. Love, manager of the traffic department of the Shipping Board. Mr. Friezer will have charge of all inland competitive rate matters.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department

Conducted by James L. Bates

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Stresses in Stack Guys

Q. (1132).—In the case of a stack supported by six guys located as shown in the illustration I desire to find the stress in each of the guys in order that the guys and fittings may be made sufficiently strong. I usually consider the stress in the thwartship guys equal to the sum of the stresses caused by (1) ship heeled to 30 degrees (static), (2) effect of wind pressure of 60-knot velocity on stack, (3) dynamic force due to rolling. In the second condition I have used the formula given in "Strength of Ships" by A. J. Murray, page 361, and applied on page 364. In the third condition I have also followed Mr. Murray's formula as used on page 364, only I am rather dubious as to the real value of the result obtained for the period of roll and the position of the center of oscillation must be assumed. I have nothing definite to base my assumptions on as the ship is not yet built. Having got this far I am at a loss how to distribute this thwartship stress among the four guys, namely, 1, 2, 3 and 4 (see sketch.) I would be very pleased to know your method of handling this problem. The fore-and-aft stress I usually treat in the same way as the thwartship stress. What is particularly puzzling to me is how to distribute a resultant stress among more than two guys.

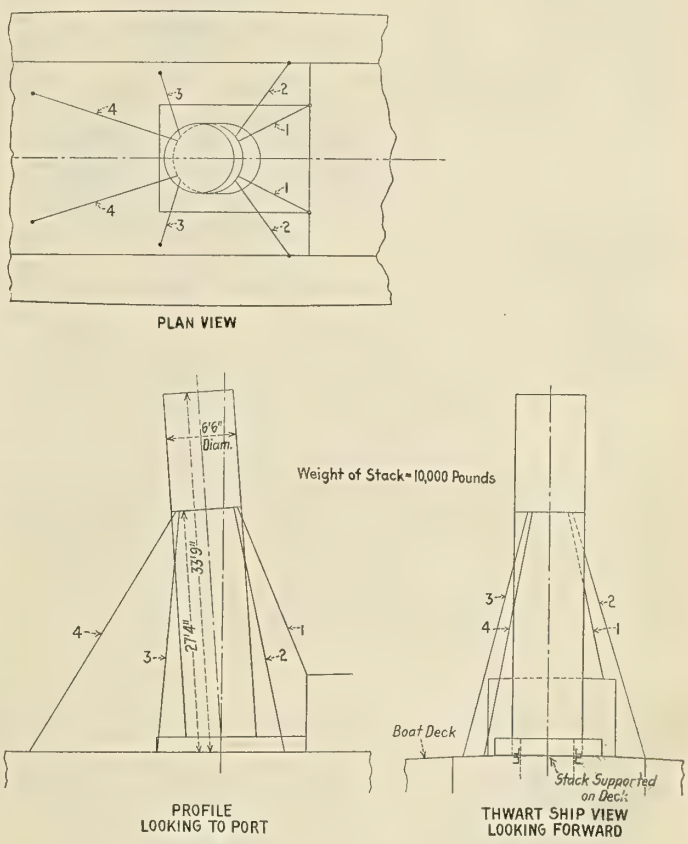
A. (1132).—A rigid solution of this problem, involving, as it does, the determination of the intensities of the stresses in four independent members, is not possible. A very clear and complete discussion of the resolution of concurrent and non-concurrent parallel and non-parallel coplanar forces and the number of unknowns that are determinate by both the algebraic and the graphic method is found on pages 15-40 of "Modern Framed Structures," Part I, by Johnson, Bryan and Turneaure (John Wiley and Sons, Inc.). The problem may be solved approximately, however, under certain justifiable assumptions and the stress in each of the several guys determined with an accuracy probably equalling that which obtains in the calculated total of the forces acting on the stack.

Consider, first, only the transverse forces acting on the stack, viz., the static weight of the stack when the vessel is heeled, the wind pressure and the dynamic effect due to angular acceleration when rolling. Assume that the resultant of these forces acting in a transverse direction perpendicularly to the stack has been determined and that its point of application is at the intersection of the transverse and fore and aft axis of the stack. Denote this resultant by F. For facility of discussion, we will deal at present with only the components of the guy stresses normal to the stack, or, in other words, we assume that the lines of action of the guys lie in a plane perpendicular to the stack. If now F, the transverse resultant force, is not contained in the assumed plane of the guys, it should be reduced to that plane by taking moments about any properly selected point, as the base of the stack for example.

Now, since every force may be resolved into two component forces, we will assume F divided into two parts, one of which bisects, approximately, the angle between guys 1 and 2 which we denote by F_1; the other component of F denoted by F_2, bisecting, similarly, the angle between guys 3 and 4. F_1 and F_2 are assumed to be concurrent forces with F. The direction of F_1 and F_2 having been determined, their intensities may readily be found by a single resolution. It will be seen at once that whether the forces acting through F_1 and guys 1 and 2 are concurrent or non-concurrent, no serious error will result from regarding them concurrent and the stresses in guys 1 and 2 are evidently the components of F_1. Similarly, the stresses in guys 3 and 4 are components of F_2.

Since we have assumed the guys acting in a plane normal to the stack, the intensities thus found are only components of their true intensities. These latter are readily found when we remember that the other components are parallel to the stack and perpendicular to the component stresses found from F_1 and F_2.

It is observed that the angle in the plan view between guys 1 and 2 is more acute than between 3 and 4 and also



Sketch Showing Arrangement of Guys

that the angles made with the stack vary widely for the different guys. This will give quite different intensities in the guy stresses. If it is desired that the guys should all be made one size, a reasonably high factor of safety should be allowed in order to care for errors in assumptions made and for unequally stressed members as will be later shown to be unavoidable.

It is to be observed that if the directions of the assumed components of F (F_1 and F_2) do not make equal angles with the fore and aft axis of the stack, their fore and aft components will be unequal and an unbalanced force will exist which tends to urge the stack in either a forward or an after direction. Effort should be made to reduce this to a minimum by a proper choice of points of attachment and levels of the guys.

In order to eliminate unbalanced forces which prevent equilibrium both of translation and rotation, the several pairs of guys should have a common point of attachment to the stack, and the components of F (F_1 and F_2) should be assumed symmetrically located with reference to the center of the stack. Further, if it is desired that stresses induced in the guys should be equal under the action of the transverse forces, then the guys must also make equal angles with the stack and the angles between guys 1 and 2 and 3 and 4 be bisected by F_1 and F_2 respectively.

You are entirely correct in treating the fore and aft forces similarly to the transverse forces. While the fore and aft are very much less than the transverse forces, it must be borne in mind that they may act simultaneously, thereby augmenting the guy stresses very appreciably.

Assuming the resultant of the fore and aft forces as having been determined and denoting the sum by f, we now impose for it the same conditions as to the point of application and plane of action as for F; the assumption as to the guys remaining the same as for transverse forces. The force f is then resolved into two equal components, one of which is coincident in direction with F_1 or F_2. The remaining operations are performed in the same order and manner as previously described. Time and labor may be saved by compounding the assumed components of F and f before making further resolutions.

It will be seen that under the combined action of transverse and fore and aft forces, the stresses in guys 1 and 2 differ from those in 2 and 3, on the same side of the stack alternating in intensity with the pitch of the vessel while the stresses in corresponding members on opposite sides of the stack are unequally stressed, the stresses on the one side being induced by fore and aft forces only. Under these conditions by no possible arrangement of the guys can equal and constant forces be maintained in several guys.

In the calculation of the force due to angular acceleration, the center of oscillation may be assumed at the waterline without serious error in results.

Relative to the value of the period of roll to be expected, reference is suggested to pages 162 and 163, "Shipbuilding Cyclopedia," published by the Simmons-Boardman Publishing Company, New York City. In case the data therein tabulated do not apply to the type or size of ship you have in hand, a fair approximation to the time for a single oscillation may be obtained by the use of the formula

$$T = .554\sqrt{\frac{K^2}{GM}}$$

in which T is the time in seconds for a single oscillation, GM is the metacentric height in feet and K is the radius of gyration in feet about a longitudinal axis through the center of gravity of the ship. The complete period will then be $2T$. You probably have calculated the value of the metacentric height. K may be taken as from $\frac{2}{3}$ to $\frac{3}{8}$ of the beam of the vessel.

Yacht Design—Underwater Characteristics

Q. (1136).—What principal underwater form characteristics would you suggest for a proposed steam yacht intended to have a maximum sustained speed of 17 knots and a trial displacement of 750 tons? The length is limited to 200 feet over all. No limitations other than those imposed by good design are placed on draft and beam.

A. (1136).—In the statement of your question, no reference has been made either to cruising conditions or to the vertical location of the center of gravity of the yacht. The former might affect the selection of the underbody coefficients and the latter the relationship between inertia of load water plain, draft, etc.

In all seagoing vessels it is desirable to secure as easy a motion in a seaway as practicable. A low value of metacentric height is conducive to this end. Making a slight allowance for loss during the development of the design and building, assume 2.25 feet as the design value of the metacentric height. Let the draft then be assumed as 8 feet to 9 feet and the height of center of gravity above the bottom of the flat plate keel 12 feet. The height of metacenter should then be 14.25 feet.

If it be assumed that we are to have a cruiser type of stern and straight stem in order to secure the advantage from the driving standpoint of the maximum length of waterline, our prismatic or longitudinal coefficient and area of midship section may vary as follows:

Prismatic Coefficient	Area of Midship Section
.54	242.6
.55	238.2
.56	234.0
.57	230.0
.58	226.0
.59	222.0

If it is decided to design primarily for the maximum speed, 17 knots, a prismatic coefficient of 0.58 or 0.59 would be suitable. If it is desired to cruise much of the time at speeds of 12 to 14 knots or less, 0.54 or 0.55 would be better. The reason for this is that the lower value of the coefficient gives easier driving at these latter speeds but for a speed approaching 17 knots the power curve would be rising rapidly and at 17 would probably be considerably higher than if the higher values of the coefficient were used.

Let us assume that a value for the prismatic coefficient of 0.58 is decided on. Then the area of midship section will be 226 square feet. We then have for a reasonable form of waterline and a height of metacenter of 14.25 feet the following taken from the Basic Design Section of the "Shipbuilding Cyclopedia":

Draft	Beam	Midship Section Coefficient	Area Midship Section
8	30.2	.86	208
8.5	30.6	.86	224
9.0	31.	.86	240
7.5	30.5	.90	203
8.0	31.0	.90	222
8.5	31.5	.90	241

We may then use either of the following combinations:

Draft, 8.5 feet; beam, 30.6 feet; midship section coefficient, 0.86
or Draft 8.0 feet; beam, 31 feet; midship section coefficient, 0.90.

These solutions are strictly accurate when the load waterline functions are read from pages 179 and 180 of the "Shipbuilding Cyclopedia" corresponding to the value of the prismatic or longitudinal coefficient selected.

The assumptions made result in a boat having a large beam to draft ratio. If the design of the ship could be such as to reduce the height of center of gravity to 11 feet and a metacentric height of 2 feet were assumed, we could use the following:

Draft, 9 feet; beam, 29 feet; midship section coefficient, 0.86

This would probably result in a more satisfactory vessel.

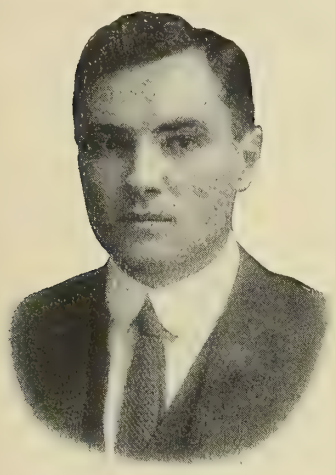
CORRECTION.—In answer to Q. (1125), published on page 562 of the July issue, reference was made to "General Instructions for Painting and Cementing Vessels for the United States Navy." We are informed that the Bureau of Construction and Repair is no longer in a position to supply these pamphlets.

CORRECTION.—The article on "Diesel Electric Propulsion," published on page 631 of the August issue of MARINE ENGINEERING, was written by Mr. Walter E. Thau, engineer of the Westinghouse Electric & Manufacturing Company, and not by Mr. G. B. Bassett, as stated. Mr. Thau and his company have taken a leading part in the development of the Diesel electric system and we regret that proper credit was not given for this excellent article.

PERSONAL MENTION

JOSEPH W. POWELL, until recently vice-president of the Bethlehem Shipbuilding Corporation, Ltd., was recently offered by Chairman Lasker the senior vice-presidency and general managership of the Emergency Fleet Corporation at a large salary. Mr. Powell could not see his way clear to accept this position, but has been prevailed on by the chairman and the Shipping Board to undertake the organization for the Emergency Fleet Corporation of the financial, accounting and sales departments, including the sale of ships, shipyards, etc., and the organization of the general offices of the corporation. Mr. Powell, who has refused to accept any salary for this service, is undertaking this work as a public service and will join the organization about September 1. Mr. Powell is forty-four years old, a Naval Academy graduate, and was a member of the Construction Corps of the Navy from which he resigned in 1906 to accept a position with the Wm. Cramp & Sons Ship & Engine Building Company. In 1914, he became president of the Fore River Shipbuilding Corporation, and in 1917 was put in charge of the five shipbuilding properties belonging to the Bethlehem interests. He organized and operated these properties throughout the war, and until his retirement early this year. The Bethlehem shipyards, under Mr. Powell's leadership, employed at one time seventy thousand men and produced, when at their maximum, vessels at the rate of one ten-thousand ton ship every other day for a period of one year.

EDWARD B. GERMAIN, formerly general manager of the Harlan plant (Wilmington, Del.) of the Bethlehem Shipbuilding Corporation, Ltd., has been appointed manager of sales of this corporation with offices at 111 Broadway, New York. Mr. Germain was graduated from the Massachusetts Institute of Technology in 1913. Until the fall of 1917 he was connected with the Aberthaw Construction Company, Boston, Mass., first as contracting engineer and later as manager. In 1917 he became connected with the Bethlehem Shipbuilding Corporation, Ltd., serving as general manager of the Moore plant, Elizabeth, N. J., the Naval Turbine plant, Buffalo, N. Y., and the Naval Boiler plant, Providence, R. I. Immediately after the war he was transferred to Wilmington, Del., and served as general manager of the Harlan plant until July, 1921, when the Bethlehem Shipbuilding Corporation, Ltd., decided to concentrate its commercial offices in New York, at which time he was placed in charge of this office with the title of manager of sales.



E. B. Germain

WILLIAM H. COLLINS, formerly assistant superintendent of hull construction at the Harlan plant (Wilmington, Del.) of the Bethlehem Shipbuilding Corporation, Ltd., has been appointed superintendent of hull construction at this plant.

WILLIAM A. QUADE, formerly general foreman of the machine shops at the Harlan plant (Wilmington, Del.) of the Bethlehem Shipbuilding Corporation, Ltd., has been appointed superintendent of machinery at this plant.

J. HARRY MULL, president and general manager of the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has been elected treasurer of the Atlantic Coast Shipbuilders Association, vice Sidney Henry, resigned.

RALPH SOLLIT, a vice-president and director of the Munsey Trust Company, Washington, D. C., has been appointed assistant to Albert D. Lasker, chairman of the Shipping Board, to succeed John G. O'Laughlin, who has resigned to become vice-president of an exporting company in New York.

HON. CHARLES C. MCCHORD, chairman, Interstate Commerce Commission, Washington, D. C., has been selected chairman of the joint committee composed of three members of the Interstate Commerce Commission and the United States Shipping Board, which has been appointed for the purpose of providing a liaison between the two governmental bodies and considering overlapping duties of the board and the commission due to amendments to the Interstate Commerce Commission Act and the passage of the Merchant Marine Act. Mr. McChord is a lawyer from Kentucky. He was born in that state in 1859 and educated at Center College, Danville, Ky. Until 1911 he practised law at Louisville, Ky., as a member of the firm of McChord, Hines & Norman. On December 31, 1910, he was appointed a member of the Interstate Commerce Commission, of which he was elected chairman in March, 1915, and re-appointed on December 16, 1915. In the early part of his career he was prosecuting attorney for Washington County, Ky. At two different periods, from 1892 to 1895 and 1899 to 1907, he was chairman of the Kentucky Railroad Commission. From 1895 to 1899 he was a member of the Kentucky Senate and was the author of the McChord Railway Rate Bill enacted by the Kentucky Legislature. In numerous railway rate cases he has served as special counsel for the state of Kentucky. During the war he was a member of the Railway Wage Commission and arbitrator of the War Labor Board.

Hon. C. C. McChord

GEORGE H. WELLS, president of the Wells Steamship Corporation, New York, and formerly connected with the freight department of the International Mercantile Marine, has been appointed to the staff of W. J. Love in the traffic department of the United States Shipping Board, Emergency Fleet Corporation.

HARRY A. RUCK-KEENE has been appointed chief engineer surveyor to Lloyd's Register as from October 1, 1921, in succession to Dr. J. T. Milton, who is then retiring. Mr. Ruck-Keene was born on November 18, 1865, and educated at the Cheltenham College, England. He served his apprenticeship as an engineer at Sir W. Armstrong Mitchell & Company, Ltd., Elswick Works, Newcastle-on-Tyne, and R. & W. Hawthorne Leslie & Company, Ltd., St. Peters Works, Newcastle-on-Tyne, and remained with this latter firm until October, 1890, when he was appointed temporary ship and engineer surveyor to Lloyd's Register of Shipping. In June, 1892, he was appointed to Lloyd's permanent staff and since July, 1909, has been assistant to Dr. J. T. Milton. Mr. Ruck-Keene is chairman of council of the Institute

of Marine Engineers, a member of the Institution of Civil Engineers, Institution of Naval Architects, Iron and Steel Institute and the North East Coast Institution of Engineers and Shipbuilders.

D. Earle Brundage, of Chicago, has been appointed advertising director of the United States Shipping Board to succeed Herman Laue.

R. S. James, formerly with the Admiral Line and other steamship companies, has been placed in charge of the newly established Seattle agency of the Luckenbach Line.

A. G. Laurent, formerly connected with the Pacific Mail Steamship Company, has been appointed manager of the Pan-American Line with headquarters at San Francisco, Cal.

W. B. Keene, formerly acting director of the division of operations of the United States Shipping Board, has been appointed chief assistant to William J. Love, manager of the traffic department for the Shipping Board.

S. Nakase, assistant manager of the New York office of the Nipon Yusen Kaisha, has been assigned to the company's head office and will be succeeded in New York by Kenkichi Sawai, who is authorized to sign documents for the company at the New York office.

Clifford D. Mallory has been elected vice-president of the United States Steamship Operators Association to succeed J. Barstow Smull, whose appointment as one of the three vice-presidents in charge of the operation of the Shipping Board fleet was announced in our last issue.

A. F. Mack has been appointed district manager of the United States Shipping Board, with headquarters at New York. For the present, Mr. Mack will have under his control Shipping Board operations at New York, Boston and Philadelphia. Practically seventy-five percent of American shipping centers in the district placed under his control. Mr. Mack is an experienced and able shipping man and will bring to the work assigned to him a wealth of knowledge that will be of the greatest value in the solution of the numerous problems which will arise in the office of the district manager. Mr. Mack was born in Cleveland, O., in 1863. For eighteen years he was with the Baltimore and Ohio and Santa Fe railroads, and in 1898 he entered the employ of the American Steel & Wire Company, serving with that company as freight agent in charge of all their traffic operation in the Cleveland District. He later became assistant general freight agent of that company and was assigned to New York where he had charge of its domestic and especially its export traffic, which under his direction assumed large proportion. Eventually this company affiliated itself with the United States Steel Corporation and one of the guiding policies of the latter corporation was the consistent exploitation of foreign fields along definite lines, for which purpose the United States Steel Products Export Company was organized in 1903. James A. Farrell, the head of that company, placed Mr. Mack in charge of the traffic and steamship departments of the Products Company. In 1916, Mr. Mack was offered and accepted the presidency of the Federal Shipping Company which was engaged in shipping operations with France. The Federal Company was later renamed and is now known as the Cosmopolitan Shipping Company. The operations of the Cosmopolitan Company cover not only France but Holland and the United Kingdom. The Cosmopolitan Company has operated as high as 28 ships and is now operating 20, and it is rated as one of the most profitable of the Shipping Board operators. As the United States Steel Products Company owned and operated as high as 25 steamers, Mr. Mack has had eighteen years' experience in the handling of ships from every angle, that of the owner, that of the charterer, and also that of an operator for the United States Shipping Board.

NEW BOOKS

Marine Rules

Recommended Practice for Electrical Installations on Shipboard. Size, 6 by 9 inches. Pages, 89. Indexed and tabulated. New York, 1920: The American Institute of Electrical Engineers.

These rules are written to serve as a guide for the equipment of merchant ships with electrical apparatus for lighting, signalling, communication and power. They do not cover the main propulsion machinery. They indicate what is considered good engineering practice with reference to the safety of the personnel and of the ship itself as well as the reliability and durability of the apparatus.

As the distribution of electric energy for the auxiliaries on shipboard in present practice is usually made by direct current, the main body of the rules relates to direct current installation; but, in addition to this, information is also given concerning recommended practice for alternating current installation.

LETTERS TO THE EDITOR

Are You a Marine Engineer, Edison Standard?

The one hundred questions given by "Old Scotch" on pages 588 and 589 in the August issue of Marine Engineering are certainly a very good test and should arouse the interest of all who see them. Those who cannot answer all the questions should at least make an effort to secure the information about those they cannot answer and so add to their store of knowledge. It should set a fellow thinking and cause him to take an inventory of himself and see how he "measures up" with what may be considered standard. Personally, I hope to see a number of letters published giving the answers, so that I may learn something that I do not know at present.

Charles J. Mason.

Brooklyn, N. Y.

[Editor's Note: Complete answers to the one hundred questions mentioned above will be published in the October issue of Marine Engineering.]

Appreciates Data Sheets

I wish to thank you for the ship data I have secured from you. At the same time I want to take the opportunity of expressing to you my appreciation for the form of presentation of data, pertaining to different types of vessels, such as that on the American passenger liner *George Washington*, on page 508 of the July issue.

I find this form is very complete with reference to marine equipment in terms of general information, propelling machinery, deck machinery, handling equipment and auxiliary machinery.

Not being a marine engineer I was somewhat at a loss to know just what this detailed data consisted of, and, as stated, such a complete form made it possible to make a complete list of the equipment for which it was my duty to make specific recommendations of lubricants, based on the analysis of the mechanical factors and the influence of operating conditions.

I agree with you that a complete list of information based on this form for all types of boats, would be invaluable primarily, due to its completeness.

Vacuum Oil Company.
New York.

R. P. Tobin, Chief,
Technical Department.

Shipping and Ship Operation News

Changes in Steamship Routes — Passenger and Freight Activities—Launchings and Other Notes of General Interest

Pacific Coast Shipping Shows Decided Betterment, With Return Full Cargoes on the Increase

Reports from Western Steamship Operators Indicate Institution of New and Additional Freight and Passenger Routes with Growing Demand for Cargo Space— Steel, Lumber and Ore Moving

Pronounced activity in West Coast shipping circles and the movement of large and increasing cargoes by water are reported from Pacific ports, according to latest information received by MARINE ENGINEERING from Seattle, Wash. The institution of additional passenger and freight routes and the bringing to the fore of full cargoes are features of a noticeable improvement in trans-Pacific shipping conditions.

Assignment of the Shipping Board steamship *West Nilus,* formerly in the Seattle-Hawaiian trade of the Matson Navigation Company, to the Pacific Steamship Company for the trans-Pacific trade is announced. With the addition of the *West Nilus* to the Oriental trade route the Pacific Steamship Company will have six freighters in that service from Seattle. Full cargoes are again coming to the front in the General Steamship Corporation's service to the west coast of South America. The steamship *Derblay,* which recently discharged 3,500 tons of West Coast ore at the Tacoma smelter, was scheduled to load to capacity in Puget Sound and the Columbia River for her next voyage to South America. The shipment will include lumber, flour, wheat and other northwest products, and the steamship *Jeptha,* which brought 4,000 tons of ore for the same smelter, was booked full with northwest products for her next voyage to South America.

The steamship *Cordova,* of the Alaska Steamship Company, instituted on August 1st a new Seattle-Astoria-Hawaii passenger and freight service of that line with a full passenger list and heavy shipments of freight. It is understood as business develops the company will add other carriers to the new service which touches Honolulu and Hilo.

Improvement in trans-Pacific shipping conditions with full cargoes each way is again in evidence. The steamship *West Jester,* one of the Shipping Board carriers operated by Frank Waterhouse & Company, sailed August 1st from Seattle, with a capacity cargo of lumber, canned salmon, steel and general freight. The *West Ivan* arrived at Vancouver and Seattle, August 4, with a capacity cargo of hemp and general freight from the Orient. She was booked to capacity for her next trip to the Orient, her shipments including lumber, hides, steel and general freight. The *West Jappa* was due to arrive at Seattle and Vancouver from the Orient late in August with a full cargo and she is already booked almost full for the return in September.

Pointing to the immediate improvement in the lumber trade between Seattle and California ports, W. R. Grace & Company are said to be returning their steam schooners to this trade in the very near future. It is stated that there is a lumber shortage of 50,000,000 feet about San Francisco and of 25,000,000 feet about Los Angeles which must be delivered in addition to the regular demand within the next few weeks.

Two Java-Pacific steamships, the *Thikenbang* and the *Simaloer,* are expected to arrive at Seattle in September to load for Japan, China and the Dutch East Indies. The Java-Pacific Line is represented by the General Steamship Corporation.

With the placing of two steamers, the *Lurline* and the *Manukai,* of the Matson Navigation Company, on the triangular run which puts Puget Sound in direct connection with the Hawaiian Islands, Seattle now has direct combination freight and passenger service to Honolulu and the Islands. The two ships took out 15,000 tons of cargo weight and measurement.

The demand for lumber in Japan is expected soon to show a marked increase as a result of a big building boom in nearly all sections of the empire. It is learned that heretofore native lumber has been used exclusively in all but the finest houses, but with the reduced freight rates and lower operating costs of mills during the past two weeks, orders for 6,000,000 feet of 4 inch squares have been placed with the Northwest mills.

The motorship *Ozmo,* of the Northern Commercial Company, arrived at Seattle recently with a shipment of gold ore from the mines of the Alaska Treble Gold Mining Company in the Kuskokwim River district. On her departure from Seattle for Bethel, the ship had a full cargo of miscellaneous shipments and mining supplies.

Official announcement is made that the French Line, or Compagnie Generale Transatlantique, has completed plans for the opening of service between the Pacific Coast and North and South America.

NEW STEAMER

Colonial Government Places Contract for Combination Boat

A contract for the construction of a new combination tug, tender and dispatch boat for the Colonial Government of the Bahama Islands has been placed with the Vineyard Shipbuilding Company, of Milford, Del. The boat is to be 120 feet over all length, 28 feet molded beam, 10 feet depth of hold, of wood construction and equipped with a 500 indicated horsepower fore and aft compound condensing engine with one Scotch boiler.

The vessel will be thoroughly equipped including mast, boom, and winch, an upper deck for day passengers, a few staterooms, and will be electrically lighted. The boat is expected to be completed in about six months, the work being under the supervision of the firm of Kindlund & Drake, consulting engineers and naval architects, 17 Battery Place, New York City.

WILL MAINTAIN SAILINGS

Receivers for U. S. Mail Lines to Operate on Schedule

Herbert Noble and Emmet J. McCormick, receivers for the United States Mail Steamship Company, have announced their intention of maintaining all sailings according to schedule. They even hope to improve the service and have declared that they desire to co-operate fully with the United States Shipping Board, and in return expect to receive co-operation from it. It is understood, however, that the Shipping Board still adheres to its original position and desires that the ships be returned.

It is reported that the first impression of the receivers is that the company can work out its own salvation. It is stated that while the company has real assets, they are not as large as they should be, but that Postmaster General Hays had advised the receivers that the Post Office Department would immediately pay the company a sum amounting to between $250,000 and $300,000 due for carrying the mails.

The *Pocahontas,* which is held at Naples under a libel for 1,000,000 lires, is to be released through arrangements made by insurance companies, but the *George Washington* is in danger of being libeled at Southampton for damages resulting from a collision which occurred during the war when that vessel was being operated by the Government.

Steamship Interests

The Coastwise Transportation Company, of Boston, Mass., has been absorbed by the American-Hawaiian Steamship Company. Under the merger the shareholders in the Coastwise Company were offered their choice between a cash consideration based on each share of their holdings, or shares in the American-Hawaiian Steamship Company, which now controls a fleet of twenty-eight vessels.

A new line of steamships to be known as the Latin-America Line, between North Pacific ports and the west coast of South America with regularly scheduled calls at Mexican Pacific ports, will be established with the first sailing on September 25, 1921, according to an announcement made by H. H. Hammer, president of the Universal Shipping & Trading Company, Seattle, Wash., northwest agents for the new service. The ships of the company comprise the steamships *Sinaloa, Baja California, Romulus, Remus* and *Regulus*. The service will be started with the coming of the *Baja California*. According to an agreement reached the Universal Company will be agents for the new service on the Columbia River and as far north as British Columbia, including Vancouver and Victoria as well as Puget Sound and Grays Harbor.

Announcement is made by the United American Lines, Inc., 39 Broadway, New York, of the establishment of a fortnightly service by the American Hawaiian Steamship Company from Philadelphia to Los Angeles Harbor, Seattle, Tacoma and Portland, commencing with the steamship *Floridian,* September 10; also an increase in their service from New York to United States Pacific Coast ports to weekly sailings commencing with the steamship *Arizonian,* August 24; establishment of a fortnightly service by the American Hawaiian Steamship Company from United States Pacific Coast ports to the principal United Kingdom and continental ports, commencing with the steamship *Alaskan,* first half of October loading.

P. Kleppe & Company, Inc., 11 Moore street, New York, announce the inauguration of the Kleppe Line's new service from Gulf ports to Brazil and the River Plate. The first steamer will be the Norwegian steamship *Argentina,* expected to sail from New Orleans about September 10. Regular monthly sailings will be maintained. The steamship company will inaugurate on September 15 a regular freight service between New Orleans, Vera Cruz and Tacoma. It is expected that the steamers *Harriet* and *Hallgjerd* will be assigned to this route.

The Atlantic Gulf & Pacific Steamship Company has taken over the new oil burning steamer *Glenora* for the western trade. This additional sailing is reported as due to congestion of freight on the Pacific Coast.

The United States Mail Steamship Company has chartered the passenger liner *George Washington* to the Raymond & Whitcomb Travel Bureau for a tour to the Mediterranean, sailing from New York in February. Indications are that there will be a record number of tours to this section next winter as the International Mercantile Marine has announced the *Adriatic* and the Cunard Line has scheduled the *Cameronia* and *Caronia* for the same voyage.

Commencing August 4, 1921, resumption of pre-war service from Puget Sound to Hawaii was inaugurated by the Matson Navigation Company, San Francisco, Cal., with a passenger and freight service, sailing from Seattle every five weeks. The steamship *Lurline* reopened the route which will be from Puget Sound to Hawaii, thence to San Francisco and Seattle. Alexander & Baldwin, Ltd., 500 Mehlhorn building, are the company's representatives.

The new 12,500 ton motorship *William Penn* has been assigned to the Barber Steamship Line of New York by the Shipping Board. The ship will make her maiden voyage to points in the Orient by way of the Panama Canal and Honolulu.

S. S. NEW YORK SOLD

Liner to Be Operated in Trade to Danzig by Polish Navigation Company

The sale is announced of the steamship *New York,* formerly operated by the American line in the transatlantic service, to the Franklin Steamship Corporation. The vessel, which is now being reconditioned, will be operated in the trade to Danzig by the Polish Navigation Company.

The *New York* has not been in active service since last fall, having been tied up at the piers of the International Mercantile Marine Company. The vessel has a gross register of 10,800 tons and is 517 feet long. Although built at the Clydebank yard of J. and G. Thomsen, the *New York* is under the American flag and is expected to sail for Danzig about September 14. The purchase price was said to be about $600,000.

SHIPS AT $5 A TON

Low Price Quoted from Abroad —Germany Active Buyer

H. D. Donald & Company, of 11 Broadway, New York, specializing in British tonnage, reports from their London agents the sale of a British steel freight steamer of 4,500 deadweight tons, built in 1898 in one of the best British yards, at a price given as £6,500 (or about $5.00 per deadweight ton at the present rate of exchange). The ship was sold to British interests.

The same company is offering several similar steamers, all carrying 100-A-1 Lloyd's classification at the same price, delivery in the United Kingdom. Cable dispatches are said to indicate that Germany is buying actively in the British ship market.

FIVE VESSEL ASSIGNMENTS

Vessel assignments announced from Washington include the following:

Newburgh, assigned Munson Steamship Line, managing agent. Withdraw Division of Operations, managing caretaker.

Lake Filimore, assigned Mallory Steamship Company, managing agent. Withdraw managing agency, Clyde Steamship Company.

Vinton County, assigned Clyde Steamship Company, managing agent. Withdraw Division of Operations, managing caretaker.

Alcona, assigned Trosdal Plant and Lafonta, managing agent. Withdraw Division of Operations, managing caretaker.

Bartholomew, assigned New York and Cuba Mail Steamship Company, managing agent. Withdraw Division of Operations, managing caretaker.

STEAMER MAILS

New Method of Handling Foreign and Coastwise Sacks

A new service for handling mails arriving in New York harbor was inaugurated at midnight, July 31. Operation of the improved system, which expedites foreign and coastwise mails 24 hours or more, was witnessed on the inaugural day by Postmaster General Will H. Hays and a group of distinguished government and railroad officials.

The new service got off with a flying start. During the early hours of Monday morning, August 1, four mail-carrying steamships were met at Quarantine by special mail boats to which their mail was transferred at once and taken to the New York post office and to trains bound for other points. The result was that hours before the steamships docked at their respective piers the mail had either been delivered in New York City or had started on its way to interior destinations.

The first boat met at Quarantine by a special mail boat was the *San Lorenzo* from Porto Rico, carrying 451 sacks of mail. It arrived at 1.30 a. m. and within 30 minutes the transfer of mail had been completed. The *Cedric,* from Liverpool, was met at 3.45 a. m. It required about an hour to transfer the 1,347 sacks of mail which it had aboard. The *Zeeland,* from Antwerp, carrying 1,361 sacks of mail, was met at Quarantine at about 4.30 and less than an hour was consumed in transferring the mail to the harbor steamer, *The President,* which got the mail to the New York post office and outgoing trains in time for the early morning deliveries, while the *Zeeland* did not dock until noon. Under the old system the mail would not have been unloaded until after the steamship had docked. The *Ryndam,* from Rotterdam, was met at Quarantine about the same time as the *Cedric.* It carried only 20 sacks of mail.

The special mail boats which will hereafter meet all mail-carrying vessels are operated by the New York Central Railroad Company. Three boats are employed in maintaining a 24-hours-a-day service, two of the New York Central's steam lighters and *The President,* supplied by the War Department at a rental of a dollar a year.

The average mail cargo carried by ocean liners arriving in New York harbor is less than half the capacity of *The President.*

The three boats operated by the New York Central in the new mail service are run on 8-hour shifts so that one of them is on duty all of the time.

After witnessing a practical demonstration of the accelerated system for ocean mails Postmaster General Hays and members of his official party expressed the opinion that the new service will do all that is expected of it.

Bareboat Charter Plan May Be New Policy Adopted by Shipping Board Within Next Thirty Days

Chairman Lasker Says Operating Vice-Presidents Will Make Complete Survey of Ship Operation Under Present Form—All Balances "On Red Ink Side"

The present system of ship allocation under the M. O.-4 contract for operators will be abandoned by the Shipping Board and some form of bareboat charter plan will be worked out for adoption within the next thirty days according to announcement from Washington. Under the present system, Chairman Lasker said in discussing the new plan, "The shipping Board is undergoing a constant loss. All of the balances are on the red ink side. We must get out of this situation some way and we have decided unanimously to try to work out some practical plan of bareboat charter in spite of the depression in shipping."

The Board's announcement reads as follows:

"The Board has directed the operating vice-presidents to make a complete survey of the operation of the ships under the present form of managing operators' agreement, known as 'Mo-4,' under which the board has been paying operators a commission on the gross receipts for operations, the board assuming all expenses of operation.

"It is the hope of the commissioners of the board that the operating vice-presidents will be able to work out and present some plan of bareboat charter within the next thirty days for submission to the board, with a view to abrogating entirely the present method of operation and substituting therefor an agreement which will provide a net rental for the use of the ships, the charterer to pay all running expenses."

$3,000,000 WIRELESS

Contract for Radio Corporation and General Electric Co.

Representatives of the Radio Corporation of America and of the Polish Ministry of Posts and Telegraphs on August 4 signed the final contract which will insure for Poland an international high power radio station of the most modern type.

This contract was executed at the office of the Polish Legal Bureau, 42 Broadway, New York, and was signed by Prince Kazimier Lubomirski, Envoy Extraordinary and Minister Plenipotentiary, Hipolit Gliwic, Commercial Counsellor of the Polish Legation and Engineer Eugene Stalinger, Division Chief at the Polish Ministry of Posts and Telegraphs.

The new radio plant will be situated near Warsaw, Poland, and it is estimated that the complete project will cost about $3,000,000. The radio system to be used is that which has been standardized by the Radio Corporation of America for transoceanic radio communication. The station will be equipped with two 200 K.W. high frequency alternators built for the Radio Corporation by the General Electric Company, and the transmitting aerial wires will be approximately two miles in length supported by ten towers each 400 feet in height.

TO REPAIR CHARLOT

Standard Shipbuilding Corporation Is Low Bidder

The Shipping Board steamer *Charlot*, operated by the Kerr Steamship Lines, will probably be reconditioned by the first of October after having been seriously damaged as a result of a collision with an iceberg recently in the North Atlantic. The ship's bows were crushed in and she was brought into Halifax for temporary repairs. At the latter port a cement bulkhead was installed and the ship brought to New York.

Bids for the work of putting on a new bow were opened by the Shipping Board at 45 Broadway, New York, on Friday, August 19, the Standard Shipbuilding Corporation, Shooter's Island, N. Y., submitting the low bid of $38,934. The specifications called for completion of the work by September 24. Other companies who bid for the job were:

James Shewan & Son, $41,294; Robins Dry Dock & Repair Company, $41,737; New York Harbor Dry Dock Company, $44,240; Morse Dry Dock & Repair Company, $45,000; Federal Shipbuilding Company, $45,984; Staten Island Shipbuilding Company, $51,360; Ira Bushey & Son, $54,853; W. & A. Fletcher Company, $61,800; Theodore Crane & Sons, $63,600.

NEW ENGINEERING CORPORATION

A corporation of peculiar interest to ship operators and repair yards has been formed by combining the casting and manufacturing facilities of John Ferguson's Foxhill Foundry and the sales and engineering organization headed by Frederick D. Herbert, who is well known in the marine field. The title of the new combination will be "Ferguson-Herbert Corporation."

In an interview Mr. Herbert stated that the object of the new corporation would be to attempt to fill a long felt need for engineering supervision of material. Mr. Herbert feels that with the staff of engineers in his organization, who are constantly in touch with repair yards and steamship lines, and with the efficient manufacturing facilities of Mr. Ferguson's shops, the combination will prove to be of great service to port engineers and operators.

Majestic, World's Largest Ship, Nearing Completion

The world's largest ship, the 56,000-ton liner *Majestic*, formerly the *Bismarck* will probably be ready for service on the New York-Southampton run next spring according to reports received in New York by the International Mercantile Marine Company from representatives of the White Star Line at Hamburg.

In tonnage the *Majestic* is 10,000 tons larger than the *Olympic* and about 2,000 tons larger than the *Leviathan*. She will have accommodations for 1,000 first class passengers, 700 second class and 2,400 third class passengers with a crew of over 1,000 hands.

The *Majestic's* power installation is the largest ever fitted in a passenger vessel, consisting of four huge turbine engines for driving the hull ahead, and four reversing turbines. The weight of a single main turbine is 375 tons. It is expected that the driving engines will deliver a maximum of 62,000 to 64,000 indicated horsepower through four shafts to as many propellers each sixteen feet in diameter. At 170 revolutions the propellers will drive the ship under normal conditions at 23 knots.

Although not provided in her original design the liner is being fitted with an approved system for using oil fuel. She is expected to consume about 5,700 tons of the liquid in a single crossing and her storage tanks will have capacity for a round voyage supply. There are forty-eight boilers.

Round-the-World Trip Planned for Steamer St. Louis

The former American liner *St. Louis*, now owned by the Anderson Overseas Corporation, is expected to sail from New York early next January, carrying the products of about 300 of America's leading manufacturers into fifty foreign ports on an American sales promotion trip around the world, consuming about a year's time. The vessel will carry the slogan "I'll tell the world."

In outlining his plans, J. Herbert Anderson, president of the company; said:

"There are a few misgivings as to the present being the best time to send the *St. Louis* around the world. It should be remembered, however, that business conditions in some parts of South America are good and will have improved by the time 1922 breaks. Also that Japan, China, India, Australia, Norway and Sweden have been to a degree free from much of the financial worry attendant on the World War. The Balkan States should be fertile fields at present for the exchange of commodities. Australia always has been a strong buyer of foreign products, and could be made stronger by more aggresive salesmanship. All of these countries will be in the itinerary of the *St. Louis*.

"While manufacturers will have to supply their own sales literature making it applicable to the language of the countries the *St. Louis* will call at, and also their highest type of salesmen, the corporation will supply interpreters and credit men. The foreign field for American manufacturers may not be just ready today for exploitation, but foreign countries are straining at the leash for the word 'Go.'"

BUSINESS NOTES

The Bolinders Company of New York, builder of marine and stationary oil engines, has opened a New England office at 53 State street, Boston, Mass., in charge of Mr. K. H. Nilsson, treasurer. A stock of engines and parts and a staff of erecting and operating engineers will be available.

The American Balsa Company, Inc., announces the removal of its general offices from 50 East 42nd street, New York City, to 305 Vernon avenue, Long Island City, N. Y.

Announcement is made that Charles Cory & Son, Inc., New York, are now the exclusive marine distributors and installation engineers of Foamite Firefoam in the United States in cooperation with the Foamite Firefoam Company. Charles Cory & Son, Inc., have developed a number of different fire protection systems both for manual and automatic control for protection against fires in boiler rooms of oil burning vessels and for tank protection of fuel oil carrying ships. Under the direction of the marine distributors, the Foamite Firefoam Company, on July 13, gave a demonstration at the Foamite Laboratories at Camden, N. J., for the benefit of the Imperial Japanese Navy Commission, representatives of the United States Navy, shipyard officials, and municipal fire chiefs.

The Cincinnati office of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has been removed from the Dwywne building to the Dixie Terminal building. Mr. A. R. Maujer, formerly of the sales-engineering force of the Pittsburgh office, is now in charge of the Cincinnati office.

The United American Lines, Inc., 39 Broadway, New York, has opened an office in the Bourse building, Philadelphia, Pa.

Lykes Brothers, operators of the Lykes Lines, have established an office at Tampa, Fla., under the management of F. L. D. Carr, formerly of the Lykes' New Orleans office. The Tampa office will specialize in the handling of phosphate shipments.

TRADE PUBLICATIONS

Material Handling Equipment.—A catalogue describing cranes, dredges, barges, tow boats, mixer boats and other equipment for inland waterways, harbors and terminals has been sent out by the Dravo Contracting Company, Pittsburgh, Pa. Structural details and arrangement drawings are given for each unit with illustrations of equipment in operation.

Man Power Multiplied.—Locomotives and trackless tractor cranes having moderate lifting capacities and considerable speed of lift are described in a booklet issued by the Brown Hoisting Machinery Company, Cleveland, Ohio. It is stated that these cranes can go wherever required and do practically any kind of handling work. Applications of different types are shown, and additional and more complete descriptions are given in catalogue K, sent out by this company.

Welding and Cutting Apparatus.—All manner of Rego oxy-acetylene welding and cutting apparatus produced by the Bastian-Blessing Company, Chicago, Ill., is illustrated and described in a recent catalogue released by this company. Together with specifications and prices of each instrument, tables of data giving torch pressures, gas consumption and the like are included in the book.

Lubrication—"Cloud and pour tests" in the matter of lubricating oils are discussed at considerable length in volume seven, number seven, of Lubrication, published by The Texas Company. The effects of improper carburetion and the flow of oil through bearings are additional subjects discussed in considerable detail. Diagrams and charts accompany the articles.

Boiler Production.—Two booklets have been sent out by the Bigelow Company, New Haven, Conn.; the first containing a general description of the Bigelow boiler, details of construction, useful tables, specifications and the like, while the second, entitled "Quality" outlines the methods used by the Bigelow Company to insure uniform high quality in all of its products.

G. T. D. Tools—The Greenfield Tap & Die Corporation, Greenfield, Mass., is distributing a new and most comprehensive catalog describing the small tools and pipe tools which comprise the greater part of their product. From the frontispiece depicting the plants of this largest manufacturer of small tools in the world, to the seventy or more pages of tables and useful information at the back of the book, this catalog contains a great deal that is of interest to the user and designer of tools and machinery. Some of the tables are new and especially instructive. The tools described include screw plates, taps, dies, drills, reamers, milling cutters, bits, arbors, countersinks, hobs, tap and drill kits, mandrels, sleeves, sockets, stocks, tap wrenches, pipe vises and pipe wrenches.

New Skimmer Boom—Pawling & Harnischfeger Company, of Milwaukee, has just issued Pamphlet TX which describes and illustrates the new Skimmer Boom designated for attachment to the standard P & H 205 or 206 Excavator-Crane. The point is made that by replacing the standard boom of either of these cranes, an efficient road grading machine is provided. In fact, this is similar to the shovel attachment brought out earlier this year and which is designed for use with either of the two types of P & H cranes mentioned.

MARINE SOCIETIES

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS
Navy Department, Washington, D. C.
President—Capt. A. J. Hepburn, U. S. N.
Secretary-Treasurer—Commander J. S. Evans, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.
Annual meeting and election, first Tuesday in October, other meetings at call of the President.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.
President—Rear Admiral W. L. Capps, C. C., U. S. N.
Secretary and Treasurer—Daniel H. Cox.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS
29 West 39th Street, New York City.

UNITED STATES NAVAL INSTITUTE
Naval Academy, Annapolis, Md.
President—Rear Admiral Bradley A. Fiske, U. S. N.
Secretary and Treasurer—Commander H. K. Hewitt, U. S. N.

NATIONAL ASSOCIATION OF MASTERS, MATES AND PILOTS
National President—John H. Pruett, 423 Forty-ninth St., Brooklyn, N. Y.
National Treasurer—A. B. Devlin, 187 Randolph Ave., Jersey City, N. J.
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

LIST OF OFFICERS, AMERICAN SOCIETY OF MARINE DRAFTSMEN
President—C. E. Deiser, 6124 Nassau Road, Philadelphia, Pa.
Vice-President—E. H. Monroe, 902 Virginia Ave., Washington, D. C.
Secretary—B. G. Barnes, 47 Saville Ave., Quincy, Mass.
Treasurer—J. B. Sadler, P. O. Box 987, Norfolk, Va.
Executive Committeemen—G. W. Nusbaum, Washington, D. C.; A. H. Haag, Baltimore, Md.; John Thomson, Bethlehem, Pa.

NATIONAL MARINE ENGINEERS' BENEFICIAL ASSOCIATION
Headquarters 311-315 Machinists Building, Washington, D. C.
President—Wm. S. Brown.
Secretary-Treasurer—George A. Grubb.

ATLANTIC COAST SHIPBUILDERS' ASSOCIATION
1701 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

AMERICAN STEAMSHIP OWNERS' ASSOCIATION
17 Battery Place, New York
Vice-President and General Manager—Winthrop L. Marvin.

AMERICAN STEAMSHIP OPERATORS' ASSOCIATION
17 Battery Place, New York

CANADA

GRAND COUNCIL, N. A. OF M. E. OF CANADA
Grand President—E. Read, Rooms 10-12, Jones Building, Vancouver, B. C.
Grand Vice-President—Jeffrey Roe, Levis, P. Q.
Grand Secretary-Treasurer—Neil J. Morrison, Box 886, St. John, N. B.
Grand Conductor—E. A. House, Box 333, Midland, Ont.
Grand Door Keeper—Lemuel Winchester, 306 Fitzroy Street, Charlottetown, P. E. I.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND
39 Elmbank Crescent, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

ITALY

COLLEGIO DEGLI INGEGNERI NAVAL E MECCANICI IN ITALIA.
Via Carlo Alberto 18, Genova.

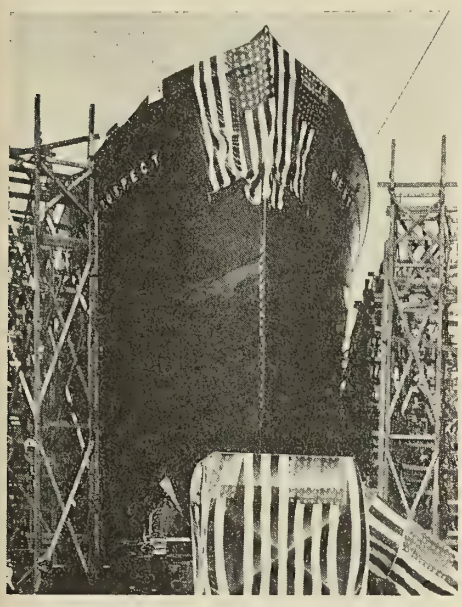
Shipbuilding and Shipyard Development

What the Shipyrads Are Doing—Dry Dock Notes —Port Expansion Plans—Engineering Projects

Thousands of Tons in New Ships Are Ready for Improvement in Marine Transportation Business

Recent Launchings in United States Show Latest Developments in Cargo Carriers with Modern Equipment—Ore, Oil and General Freight Ships Added to Various Fleets

The *West Prospect,* 11,000-ton freighter, the thirty-fourth large steel hull built by the Los Angeles Shipbuilding & Dry Dock Company, was launched from the ways of that company in Los Angeles Harbor, Cal., on July 30, 1921.



Shipping Board Freighter West Prospect Ready for the First Dip

Since December 15, 1917, the company has converted seventy acres of tide lands into a shipbuilding and ship repair plant recognized as among the best designed and equipped on the east or west coasts and from this plant has launched thirty 8,800-ton steel freighters and counting the launching of July 30, four 11,000-ton flush deck freighters.

Of this total of thirty-four vessels the plant has supplied twenty-six with the main marine engine of its own design and building which develops 3,500 horsepower at 85 revolutions or a little over 4,000 horsepower at 90 revolutions. Besides the main engines, practically all the auxiliary machinery, equipment and furnishings are also the products of the various shops of the plant.

The first of the 11,000-ton flush deck freighters was the *West Lewark,* launched February 24, equipped, completed and delivered July 7 and then chartered by Williams, Dimond & Company, Pacific Coast shippers for Pacific-European trade. The *West Lewark* on her maiden voyage to Columbia River and Puget Sound ports to take on cargo for Europe is said to have attracted the closest attention from shipping men generally who claim that she presented in the highest degree the combination of economy in cargo handling and storage with speed and that as such this class of freighter marked the biggest advance in cargo carrying ships made by any shipyard in the United States in the past four years.

Mrs. Milo A. Baker, who sponsored the *West Prospect,* is the wife of the vice-president of the Baker Iron Works and sister-in-law of Mr. Fred L. Baker, president of the Baker Iron Works, and also president of the Los Angeles Shipbuilding & Dry Dock Company.

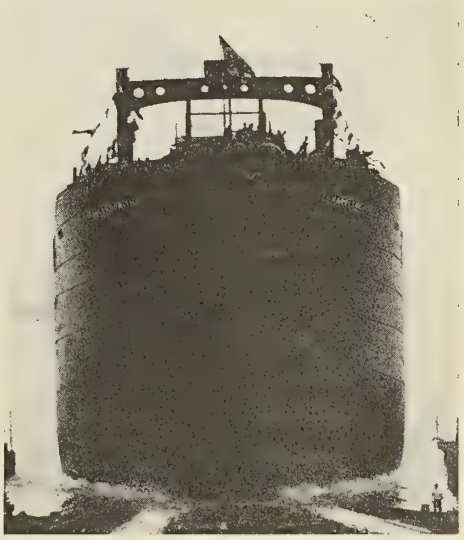
Oil and Ore Vessel Launched at Sparrow's Point, Md.

The first of the combination ore and oil vessels building at the Sparrow's Point Plant, Sparrow's Point, Md., of the Bethlehem Shipbuilding Corporation, Ltd., was launched on July 12, 1921. Delivery is scheduled for about the middle of September. This vessel, the *G. Harrison Smith,* is being built for the International Petroleum Company and is one of four ships of this type under construction at Sparrow's Point, the other three being for the Ore Steamship Corporation.

The *G. Harrison Smith* is distinctive in that it is the largest vessel ever constructed at this plant, having a deadweight capacity of 20,000 tons and a length overall of 571 feet, 6 inches. It is designed for carrying a full cargo of either ore or oil in separate compartments. The ore cargo will be carried in a narrow elevated hold 30 feet wide and 360 feet long. It is divided by watertight bulkheads into three compartments, each of which is served by three large hatches extending the full width of the ore hold.

The oil space, alongside and below the ore space, is divided by a longitudinal bulkhead extending from the keel to the ore hold. The foremost and aftermost compartments are for fuel oil and the tanks between these are for cargo oil. There are no summer tanks.

The wing spaces, acting as expansion trunks, on account of their depth afford the greatest possible flexibility for carrying liquid cargoes of varying density and adjusting the trim under all conditions of load.



Launching 20,000-Ton Combination Oil and Ore Vessel

The Levant Arrow an 18,277-Ton Oil Tanker

The *Levant Arrow,* built for the Standard Transportation Co., was launched in the South Yard of the New York Shipbuilding Corporation, Camden, N. J., Monday evening, July 25, 1921 at 7 o'clock. The vessel was christened by Mrs. Beryl H. P. Thomas wife of Mr. L. I. Thomas, a director of the Standard Oil Company of New York.

The overall dimensions of the ship are 485′ in length, beam 62′6″ and depth 39′6″. The vessel will have ten double main cargo tanks with a combined capacity of 3,500,000 United States gallons. It has a displacement of 18,277 tons and carries a crew of 62 men.

10,000-Ton Tanker Launched

The 10,000 deadweight ton oil tanker *Robert G. Hopkins,* built for the Tidewater Oil Company of New York, was launched on Saturday, August 6, 1921, at the Chester yard of the Merchant Shipbuilding Corporation, Chester, Pa. The ship measures 440 feet over all length, with a 58 foot beam and a molded depth of 33 feet. She is capable of carrying 70,000 barrels of cargo oil in her 18 main oil tanks, besides 9,550 barrels of fuel oil.

Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Repair Contracts, Hoboken, N. J.—A contract for general machinery and deck equipment overhaul in addition to dry docking, reconditioning holds and bunker spaces on the United American Line steamship Franklin has been awarded to the W. & A. Fletcher Company, on a bid of $15,000. Other contracts awarded to the Fletcher Company during the past week included general overhauling and voyage repairs to the Standard Oil ship El Capitan; dry docking and bottom work on the Holland American ship Beenbijk; and a survey of the American Hawaiian ship Dakotan.

Car Float Contract, Shooters Island, N. Y.—The Standard Shipbuilding Corporation has been awarded the contract for cutting down two car floats of George B. Stearin, Inc., 90 West Street, New York, making them into four scows. The car floats are about 300 feet long and will be made into four scows each 150 feet long.

Salvage Steamer, Mobile, Ala.—It is announced that a salvage crew from the Alabama Dry Dock & Shipbuilding Company has left that plant for the Mexican Coast to raise the sunken steamship Westerian. The ship is believed to be lying about 20 miles off the Campeche Coast and it is hoped that the vessel will be successfully raised and brought back to Mobile for reconditioning. Mr. J. K. Moffatt is in charge of the salvage crew.

Vessels under Repair, Mobile, Ala.—Vessels under repair at the plant of the Alabama Dry Dock & Shipbuilding Company, during the past week include the steamships City of Brunswick, Santa Alicia, U. S. L. H. S. launch No. 82, and schooners Philip M. Brooks and Maplefield.

Reconditioning Steamer, Brooklyn, N. Y.—The contract for reconditioning the passenger steamship New York which was recently sold to the Franklin Steamship Corporation of New York City and will be operated in the trade to Danzig by the Polish Navigation Company, has been awarded to the Morse Dry Dock & Repair Company. The ship was formerly in the transatlantic service of the American Line and is to be completely overhauled. The Morse Company has also been awarded the contract for general overhaul of machinery and plate work on the American Hawaiian steamship Dakotan. The ship is of 6,660 gross tons, 407 feet long and it was reported that the repairs would amount to about $17,000. At the same yard for general overhaul and plate work are the tank ship John D. Rockefeller of the Standard Oil Company and the W. L. Steed of the Pan-American Petroleum Company.

Keel Laid for Tanker, Wilmington, Del.—The Harlan plant of the Bethlehem Shipbuilding Corporation recently laid the keel of the 2,500 ton tanker to be built for the Atlantic Refining Company.

Contracts Awarded, Hoboken, N. J.—The steamship American Star has been awarded to the W. & A. Fletcher Company for general repairs, at a price close to $5,000.

Ferry, DeFuniak Springs, Fla.—The Walton County Commissioners plan to construct a ferry at Santa Rosa, north landing at Old Bayview on Black Creek and southern landing at Point Washington. A $50,000 bond issue is contemplated.

Shaft Repairs, Hoboken, N. J.—The W. & A. Fletcher Company has been awarded the contracts for renewing a shaft in the Hudson river passenger steamer Washington Irving and a similar job on the D. L. & W. ferryboat Paunpeck. It is expected the total cost will be close to $28,000.

To Complete Vessels, Vancouver, B. C.—It is announced that the Dominion government has decided to take over the work of completing three barkentines, the construction of which was started at the Cholberg Shipyards. All British Columbia shipyards are said to have figured for the work.

Steamer Repairs, Baltimore, Md.—The contract for repairs to the Atlantic, Gulf & Pacific Line steamer Liberator was awarded to the Union Shipbuilding Company, Baltimore, Md., on a bid of $1,200. The Shipping Board has awarded the contract for repairs to the steamer Coelleda to the H. E. Crook Company, also of Baltimore, at a price of $1,095.

Prospective Reconditioning, New York.—Although it was reported that Sloan Danenhauer, 11 Broadway, New York City, was contemplating reconditioning the ship Isle De Luzon, it was stated at the offices that no decision had been reached as to which of the Danenhauer ships will be converted. First reports were to the effect that the Luzon would be made into a wrecker.

Buoy Construction, Charleston, W. Va.—The Charles Ward Engineering Works, on a bid of $2,988 and 75 days, was low bidder for furnishing nine second and third class tall type man buoys for the Department of Commerce, lighthouse service, Tompkinsville, N. Y. There were 20 other bidders, the prices ranging up to $15,900 and 180 days.

Barges, Pittsburgh, Pa.—It is reported that the Dravo Contracting Company has recently secured a contract for the construction of two 100,000-gallon molasses barges which will be fabricated and assembled complete at the Neville Island plant of the company and will be knocked down for shipment to Havana for Cuban service.

Repairs to Schooner, Chelsea, Mass.—Needing a new keel and much new planking, the auxiliary fishing vessel, Flora L. Oliver, which ran aground recently while inbound from the grounds has been towed to the shipyard of Richard T. Green & Company, where it will undergo temporary repairs prior to being permanently refitted at Gloucester.

Supply Contract Award.—The American Chain Company, 1054 Grand Central Terminal, New York City, is announced as the successful bidder for a large number of 15 fathom pieces of open link buoy chain and 40 bell buoy bridle chains with rings attached, bids for which were opened at the office of the Superintendent of Lighthouses, 3d District, Tompkinsville, New York, on July 29. The total price submitted was $27,877.64. The contract is to be completed within 60 calendar days.

To Build Barges, Roanoke, Va.—Announcement is made that the Virginia Bridge & Iron Company, with branch plant at North Memphis, Tenn., has taken orders for the construction of four barges for oil service in the vicinity of New Orleans. The boats are to be 125 feet in length. The company, with a branch at North Memphis, Tenn., has acquired about ten acres on the Wolfe river, formerly occupied by the Anchor Saw Mills, for the production of all-steel barges.

Repair Contract Awards, Baltimore, Md.—The Baltimore Dry Docks & Shipbuilding Company was awarded the contract for docking and repairing the steamer Auburn at its bid of $4,146. The Globe Shipbuilding Company bid $4,266 on this contract and the Bethlehem Shipbuilding Corporation, $5,940. The steamer Clarence will be repaired by the Union Shipbuilding Company, the contract having been awarded by the Shipping Board to this company on its bid of $804.

Fire Prevention Apparatus to Be Installed.—To minimize the danger of fires on board ships of its fleet, the Standard Oil Company of New Jersey is installing Foamite Firefoam apparatus, manufactured by the Foamite Firefoam Company. The first of its Pacific Coast fleet to be so equipped is the 10,000-ton tanker Bradford. This system is recognized by the United States Steamboat Inspection Service, and it is expected that all oil carriers of the Pacific Coast will be fitted with it.

Repairs to Steamer, San Francisco, Cal.—Repairs aggregating $40,000 will be made on the Matson Navigation Company's liner Hawkeye State. The work necessitated the retubing of seven of the eight boilers of the vessel, and sealed bids for the work were submitted on July 26. The Moore Shipyards and the Bethlehem Shipbuilding Corporation, San Francisco, Cal., are said to be the only two plants equipped to do the work.

Repair Bids.—The Staten Island Shipbuilding Company, New York, was low bidder for the job of repairing the United American Line ship Transportation, bids for which were opened at noon August 12, at 39 Broadway, New York City. The bid was $6,170 and 12 days, other figures being Standard Shipbuilding Corporation, $7,348; Morse Dry Dock & Repair Company, $6,995; Robins Dry Dock & Repair Company, $7,080; New York Harbor Dry Dock Company, $7,970; W. & A. Fletcher Company, $8,390; Ramberg Dry Dock Company, $9,953; National Dry Dock Company, $10,892; Crane Dry Dock Company, $11,600.

Repair Contract, Baltimore, Md.—One of the largest repair specifications asking for bids by the Shipping Board at Baltimore was opened recently, but being beyond the amount permitted without being referred to the office in New York, the successful bidder was not named. The bids were for repairs to the steamer Cusnoc and included her turbines. Bids submitted are as follows:

H. E. Crook Company	$11,654
Baltimore Dry Docks & Shipbuilding Company	12,489
Spedden Shipbuilding Company	13,778
Globe Shipbuilding Company	14,027
Obrecht Company	14,185
Union Shipbuilding Company	14,638
Bethlehem Shipbuilding Corporation	14,700
Westinghouse Electric Company	15,424
Curtis Bay Copper & Iron Works	15,698

Barges, New York.—The New York Central Railroad is planning to build several grain barges and car-floats for service in New York harbor. Authorization of this construction is expected in the near future. Further details can be obtained from the marine department of the railroad, 6 Beaver street, New York City.

Cable Steamer.—The awarding of the contract for the Western Union cable steamer, plans and specifications for which were sent out by J. W. Millard, naval architect, 17 State street, New York City, is being held up awaiting bids from shipyards in Great Britain and France. This vessel will be equipped with Diesel electric propelling machinery, installed in four units. It is understood that the vessel will be registered and operated under the British flag, regardless of whether it is built in an American or foreign shipyard.

Plan New Vessels.—It was stated that preliminary plans are being considered for new passenger vessels for the Great Lakes. Although authentic details were not available, it is understood that, with the adoption of certain changes in the Seamen's Act, construction of one and possibly more passenger ships for the Lakes will be undertaken. Naval architects say that no new vessels have been built in recent years for the Lakes passenger traffic.

Ferryboats, San Francisco, Cal.—The Six-Minute Ferry Company, 948 Market street, is planning to build at least three, and possibly four, all-steel ferryboats for operation between San Francisco and Oakland. This company already has in operation two boats, the Vallejo and San Jose. The Golden Gate Ferry, San Francisco, Cal., is also planning the construction of two additional ferryboats for its service.

Passenger Vessel, In the Puget Sound district plans are being made for the construction of a 250-foot passenger ship.

Todd Plant Awarded Wenatchee Overhaul.—The contract for making alterations and improvements on the Shipping Board liner Wenatchee has been awarded to the Todd Shipyard Corporation, Seattle, Wash., plant, on a bid of $149,600. Extensive machinery repairs are included in the overhauling. Other bidders were the Bethlehem Shipbuilding Company, San Francisco, Cal., $162,315; Los Angeles Shipbuilding Company, $155,485, and the Moore Shipbuilding Company, San Francisco, Cal., $177,520.

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Protection or Subsidies

THE sole reason that an increasing number of American ships are being tied up and that the percentage of the traffic carried in our vessels is steadily decreasing is the lack of a shipping policy embracing the discriminatory features of the Jones Act or an equivalent subsidy. No matter how efficient a Shipping Board may be, no matter if the most experienced practical men direct our vessels, the fact remains that the cost of operating ships under the various flags varies almost directly as the cost of living in the respective countries.

It is no more feasible to expect our seamen to accept a foreign standard of wages or living than it would be to get this concession from any other class of American labor; but even if it were possible, the wages are but a small percentage of the operating costs which are affected by the cost of living in this country. It is therefore just as well that capital has refrained from investing liberally in American shipping because if it had there would have been such a number of failures in the last six months that it would have taken years for our merchant marine to get over it.

Private capital as a rule has to be shown that there is a reasonable chance of profit before it can be interested but it is always on watch for opportunities. Our pioneer purchasers thought there was an opportunity for they were not informed that the Merchant Marine Act was not to be enforced. Had it been enforced, they would have been justified and the propaganda that the Government ships cannot be sold at any price would never have been started.

We may sink, sell, or sail our ships but we must pay a subsidy on our commerce, call it by whatever name you please. From 1870 to 1890 we paid foreign shipowners $3,170,000,000 for carrying the goods which our own merchant marine was unable to take. The year before the war we donated to foreign shipping $390,000,000 and last year this sum was estimated at over $700,000,000. Shall we continue to pay this enormous tribute to foreign vessels, shall we protect our shipping by the discriminatory provisions of the Jones Act or shall we grant an equivalent direct subsidy?

A decision one way or the other cannot be evaded much longer. The tariff is a protection to all industries but shipping, it increases the cost of operating our vessels and it restricts imports, preventing full return cargoes. Why then, as long as we have a tariff, should we not enforce the differential in favor of American vessels? It would automatically add a billion dollars to the value of the Government fleet and it would encourage the construction and operation of passenger liners. Passenger ships are needed badly to balance our fleet, to carry our mails, to educate cadets in engineering and navigation, to be at the disposal of the Government in case of need as transports and to increase our commercial relations with foreign countries by furnishing regular and speedy connections for cargoes and merchants. And in addition to this, they will help to establish a market for bulk commodities which will follow in the slower and less expensive cargo ships.

The Leviathan

ON page 735 of this issue, a complete description is given of the world's largest boat, the *Majestic,* which will join the White Star fleet of Atlantic liners next spring. With the *Imperator* sailing under the Cunard emblem, but one of the trio of the finest and largest ex-German ships remains in useless condition rotting at its dock and that one is the *Leviathan,* whose misfortune it is to fly the American flag.

The propaganda has gone out that these big ships do not pay except, possibly, as an advertisement for the line on which they run and Congress must have swallowed this illusion, line, hook and sinker, or it would have insisted on

the reconditioning and commissioning of this vessel long ago. Take the *Olympic,* for example; on her last trip she carried over 1,000 first and second-class passengers to England and brought back 770 first-class and 505 second-class, to say nothing of steerage passengers. If anyone thinks that with the rate that you have to pay to travel on the few boats of this type, which you can number on the fingers of one hand, the "ewe lamb" of the White Star fleet is not netting hundreds of thousands of dollars of profit on each round trip except in the winter season, then they lack common sense. If the truth was published, it is a safe bet that this ship is making good any losses occurring in the operation of the smaller vessels.

Suppose the *Leviathan* was in commission on an American line. Outside of the people interested in shipping or living in Atlantic seaports, the *Leviathan,* with the possible exception of the *George Washington,* is the only American transatlantic liner that is really known. A trip abroad is a big event for most everyone and many people would consider it well worth the extra fare that this ship would charge to be able to say on their return that they went at least one way on the *Leviathan.* Not only this, but the *Leviathan* could on account of its size, furnish many extra inducements and luxuries that are not possible in smaller ships. That this is not idle talk is proven by the fact that in spite of the extra fare the demand for accommodation is greatest on the big ships.

The *Leviathan* should be in service next spring and it could be if we were in earnest about it. The *George Washington,* efficiently reconditioned in ninety days, proves that. How can we get action on this big ship? Public opinion would not allow it to be sunk, which, after all, would be more sensible than letting it rot. We ask our readers to use their ingenuity on this problem. How about asking two friends, either by word or by letter, to each send one vote to their Congressman on the subject and pass it along to two more a la endless chain?

The Bare-Boat Charter

WHILE it is undesirable to continue the system of allocating Government vessels to operators on the M.O.4 agreement, whereby the operator receives a percentage of the gross freights whether the voyage is successful or otherwise, any longer than absolutely necessary, the Shipping Board should and probably will give very careful consideration to the claims of the operators before compelling them at this time to change over to a bare-boat or partnership system.

Undoubtedly there are many routes that cannot be made to pay until trade conditions are better, therefore where there is no reason to suspect that an operator is dishonest, careless or negligent, the Board should go as far as it possibly can to hold up the berth until it can be proved that the losses are avoidable. Many routes that are losing money today will be an asset when trade is revived, perhaps after a very few more voyages. No doubt there have been cases where the Government has been cheated or at least its interests ignored but the fact that Mr. Smull has never heard of a case where concerns who both own and charter ships have tied up their own ships when there was a shortage of freight to operate Government vessels where there was no chance for them to lose proves ship operators are at least as honest as any other class of men.

It would seem, however, that just as soon as the traffic warrants a bare-boat charter should be put into effect even if the rental has to be made very low. Until this is done our shipping will remain on an artificial basis which will prevent its proper development. *Fairplay* has pointed out that with a low charter hire there is a grave danger that operators will find it more advantageous to continue chartering in preference to buying. This, however, is false reasoning for as soon as substantial profits are made at a low charter rate there will be plenty of competition that will force the rates higher and higher until they reach a point where it will be to the interest of the operator to purchase outright.

Operating Cost per Ton

ACCORDING to Mr. J. B. Smull, vice-president of the Emergency Fleet Corporation and director of operations for the Shipping Board, the cost of operating the six Government vessels, which the firm that he was connected with have been running from New York to Hull and from New York to Bristol, has been $48 per deadweight ton per year. This cost includes the overhead of the office, the 5 percent commission paid by the Shipping Board to the operator, the insurance, depreciation and all of the expenses of operating the vessels including repairs.

Mr. Smull stated that these figures should not be taken for the average rate per ton for all vessels all over the world because there is something that changes with every trade. The ships on this particular berth should make eight round trips a year and the foreign ports that they enter are not expensive. Repairs and provisions are much cheaper in England than at Alexandria, Cape Town, South America, Australia or China, and if the voyage is longer there are more repairs to be made and more provisions to be brought away from home.

Surprising as Mr. Smull's statement is, that ships running on one of the cheapest berths cost $48 a deadweight ton per year to operate, his statement that his firm was able to show a small profit at this cost on the existing freight rates and under present conditions is even more remarkable. And, still further, Mr. Smull expressed the opinion that under the present freight rates and conditions the operating cost per deadweight ton could be raised to $60 before getting on the red-ink side of the ledger.

Although Mr. Smull states that the fixed charges are included in the $48 he did not give the book value on which these charges were based. It is evident, however, from an estimate of the operating costs from other sources which, excluding fixed charges, approached very closely to $40 a deadweight ton per year, that he does not figure on much over $50 a deadweight ton as the proper value upon which to base interest, insurance and depreciation.

It would seem, therefore, that the Shipping Board, under

present conditions, would not be justified in charging more than 50 cents a deadweight ton per month on a bare-boat charter. They probably should go lower than this on expensive berths and even take a loss on some routes but, on the whole, where due care and attention is paid to the business, there is still money to be made in shipping. When business returns to normal, as it surely will, competition will automatically increase the charter rate but as the Government has such a large number of vessels, the benefit of any increase in the volume of trade will naturally go to the ship operator until all the ships are placed in commission.

The Marine Exposition

THE Marine Exposition, which will be held at the Central Mercantile Building, New York city, during the week of November 14, 1921, under the auspices of the National Marine League and the Marine Equipment Asosciation of America, will for the first time combine the opportunity of inspecting the latest improvements in marine equipment with the privelege of attending the conventions of the Society of Naval Architects and Marine Engineers and the American Society of Marine Draftsmen.

The decision of the Marine Equipment Association of America, Woolworth Building, New York City, to hold this exposition at the same time and in conjunction with the conventions of as many marine organizations as possible means a great deal to the members of those societies. In the past many have not been able to attend both events and they have had the hard task of deciding whether it was more important for them to attend the exposition or the convention. Many others who in the past have failed to attend either will undoubtedly see in this "American Marine Week" an opportunity that they cannot afford to miss.

No one can keep up to date by sticking to his desk, neither can he progress without exchanging views with others nor in these strenuous times without knowing all about the latest types of marine equipment. Seeing is learning as well as believing and many shipping and shipbuilding companies would gain much by sending their department heads to the exposition with instructions to prepare a written report on the exhibits pertaining to their particular work.

The success of the exhibitions, however, means a great deal more than a social and educational gathering to the marine field. It is a great advertisement for the American merchant marine and one of the best ways to awaken the interest of the public in maritime affairs. The National Marine League has directed its entire efforts for several years to interesting the American people in the importance of our merchant marine and it was largely for this purpose that the first two marine expositions in New York were held. The support of the man on the street, in the factory and on the farm is needed for they hold the majority of votes and until they are convinced that the future prosperity of our country depends on the merchant marine, shipping will not get the financial and legislative backing that it should.

In order to make this exposition of the most value to the merchant marine all maritime organizations are most urgently invited to cooperate. Whether you are shipbuilders, repair men, ship owners, ship operators, shippers, underwriters, officers, engineers, or crew this is your show. Remember that this is the first time that all marine organizations have had the opportunity to work in conjunction. Shape your course now to attend this big marine event and help to make "American Marine Week" a real factor in the development of our merchant marine.

Operation Has Helped Carry Construction

ONE of the interesting facts brought out at the hearings on the Shipping Deficiency Bill before the subcommittee of the House Committee on Appropriations was "that from the inception of the Shipping Board up to February 28, 1921, the receipts from operations of vessels, voyage and charter revenue and revenues incidental to vessel operations were $1,051,893,910.04, and that the expenditures on the operation of vessels, voyage expenses, maintenance, charter hire, etc., were $777,250,380.11."

In other words, the Shipping Board, which under the last administration had five different chairmen in less than four years and part of that period only two members, actually made $275,000,000 profit from operations up to the time that the new administration took office. In addition to managing by far the largest fleet ever operated under one head, it attended to a few other trifling details, such as the construction of several million tons of new vessels. Perhaps, if the Board had not had to take this profit and the appropriations that Congress has made for the construction of new vessels, it would be on its feet today in spite of the losses made during the last year.

But it is not our object to dwell in the past. History will establish the proper credit for those who accomplished the greatest shipping achievement of all time. What we want to know is how long does the press of this country, including several marine publications, intend to keep up the propaganda that our shipping is in such a terrible condition that there is no hope for it? Why not drop this "colossal wreck" and "sick merchant marine" talk and devote the space to the ways and means of developing our foreign trade? Of what use is our surplus of money and almost every kind of raw and finished materials when millions are unemployed? We have the surplus and the ships, but until a way is found to send that surplus in our ships to foreign countries where it is so badly needed there is very little hope for much improvement in the purchasing power of our people at home.

Economy and the Naval Program

THE continued uncertainty of the status of the 1916 naval program and the piecemeal appropriations granted by Congress for the completion of this work show only too plainly why Government ownership or direction of industrial projects costs the taxpayers more money than it should. The arbitrary stoppage of work on our naval vessels not only places a severe load on the shipyards and the manufacturers of marine equipment by forcing them to carry their investments for an indefinite period without any

financial relief but it also increases the individual cost of each ship.

It seems elementary and almost unnecessary to point out that the Government is making another record for extravagance in stopping this work, the greater part of which is well underway and getting along toward completion. Shipbuilding, whether on merchant or naval vessels, requires a large and highly trained personnel and to disrupt and then have to reorganize the forces in the shipyards and manufacturing plants engaged in this work is the most wasteful procedure possible.

Those of the civilian employees of the Navy Department who have been fortunate enough to be retained on a five-day week basis and the workmen in private organizations will find it difficult to keep up their interest and production standard in a work whose date of completion is scheduled as indefinite. They can hardly be blamed if they adopt the "ca camy" policy of making each individual job last as long as possible.

Economical production has been repeatedly advocated as the only means of the industrial salvation of the world, and the average American workman is capable of understanding the logic of this principle. But he also knows that when a private firm makes a contract it has to live up to it and he can hardly be expected, when work that Congress has authorized and the Navy Department has contracted for is suspended, to do his best.

This work will eventually have to be completed and now that England has authorized the construction of four new dreadnoughts there is no reason why the disarmament conference should be influenced by our completion of a 1916 project. On the other hand, the temporary stoppage of this work is fooling no one but it is hurting our marine industries and it will cost us much more money in the end.

Foreign Trade Policy Needed

THE greatest need of the present, both for the revival of normal trade conditions in this country and for the development of our merchant marine, is a foreign trade policy that will force into motion the unrestricted interchange of commodities between the stagnant markets of the world. The adoption, at this time, of adequate means to accomplish this purpose would do more toward restoring prosperity than those who are directing our destinies apparently realize; for it is estimated that over one-quarter of the production in the United States is surplus and must find a market which is other than domestic.

Granting that the United States must protect itself against unrestricted floods of certain classes of imports which are the result of cheap wages and depreciated exchanges, it is nevertheless true that the only practical way that the world can repay us or continue to take our exports is either by the means of their goods or their services. If our surplus cannot be marketed abroad because a high tariff restriction prevents the payment for it in the only feasible way, then we may look for a readjustment in our production that will be a great deal more harmful than any foreign competition that our industries might have to contend with.

A tariff that walls in our industries will delay the restoration of the world's markets and prevent us from enjoying the substantial rewards that would naturally come to us. The markets of the world can easily absorb our surplus in normal times. Reasonable foreign competition will have a wholesome effect on the cost of living and it will allow us as a nation, that is the best equipped for the purpose, to do our share in the reconstruction of the world and thereby hasten the payment of the vast debts that are owed us. We must have imports as well as exports or there will not be profitable employment for our merchant marine. Restricted imports and increased exports form an ill-adjusted trade relation that cannot continue for any length of time but a liberal foreign trade policy that will help other nations to prosper with us will solve the unemployment question, dispose of our extra products, find cargoes for our ships and reduce our taxation.

Trade Routes

THE niggardly appropriation that Congress has given the Shipping Board for the balance of the year and the failure to enforce the Jones Act have caused the tying up of an increasing number of Government ships. The Board should not be blamed for taking off these vessels for it cannot run them without money but Congress is forcing it to violate the law, which says that the Board is directed to "put into operation from the ports in the United States or any territory, district, or possession thereof to such world and domestic markets as in its judgment are desirable for the promotion, development, expansion and maintenance of the foreign and coastwise trade of the United States and an adequate postal service," such vessels as will meet these requirements. It further states that if the Board cannot sell or charter ships for these routes it shall operate them itself until the business is developed so that the ships may be sold and the service maintained.

It cannot be too strongly stated that the tying up of these vessels and the abandoning of trade routes are destroying what confidence is left in the American people in our merchant marine. Not only this, it is proclaiming our failure to the world and encouraging foreign monopolies to repeat what was done at Alexandria when the Liverpool lines said that not a pound of Egyptian cotton should go in American bottoms.

We have every reason to believe that Congress is very anxious to sell the Government fleet but, if it discourages the members of communities interested in new trade route developments who, as we see it, are the prospective purchasers of American maritime securities, who will take their place?

Can it be that Congress has such an unfortunate opinion of the value of our foreign trade that it would sanction the abandonment of direct trade routes forcing our goods to go via foreign countries? Does it actually contemplate by withholding appropriations to hand over to foreign competitors the business which has been built up and developed by American concerns? If such is the case there is bound to be an awakening when the American people realize what has been done to their merchant marine.

Can a Shipping Subsidy Bill Pass Congress?

By Winthrop L. Marvin*

Whether discriminating duties or subsidies are the royal road to success for American shipping will be actively debated this coming winter, as in so many seasons past. Both have their merits; both their limitations. But it is exceedingly important that the questions presented by these two methods should be temperately discussed. They are not necessarily antagonistic or even alternative. We have tried both systems in our national life, and there are many Americans who think today that the best features of both may wisely be embodied in any supplementary legislation that may be essential to the complete outrounding of the Jones Merchant Marine Act of June, 1920.

THE most frequent objection urged to the subsidy plan is that "The American people will not stand for subsidies —Congress will never pass a subsidy law." All of which is simply an unconscious result of very persistent foreign propaganda. As a matter of fact, we have had subsidy laws in the United States sustained by an overwhelming majority of the nation. The first example was the Ocean Mail Law of 1847, enacted on the recommendation of a Democratic President, Mr. Polk. This earlier subsidy system gave the country its first transatlantic and South American steamship lines. That legislation proved as beneficial to steamship building and operation from American ports as the original discriminating duties and tonnage taxes had been to the sailing ships of the first half of the nineteenth century. As Dr. David A. Wells said of these pioneer steam lines:

"During the single year 1849-50 we increased our ocean steam tonnage one hundred and thirteen percent, and the seagoing qualities and performances of our vessels were so admirable that the Cunard Company, which had then been in operation ten years, was obliged to bring out new ships to compete with them. The prospect, therefore, at one time was that the United States, although late in the start in this new department of foreign shipping, would soon equal, if not overtake, her great commercial competitor."

When both America and Britain were subsidizing their mail lines, all the honors of the Atlantic went to the Stars and Stripes, floating over the larger, the more comfortable and the swifter ships, which commanded the bulk of the best cabin passenger traffic. Our ocean steam tonnage, which amounted in 1849 to only 20,870, had risen in 1855 to 115,045. It is a matter of history—how the sectional quarrel over slavery between North and South broke down the American subsidy system because of its rapid enhancement of the sea power of anti-slavery New England, New York and Pennsylvania. That is to say, our early subsidy experiment was abandoned because of its very success.

Postal Subsidy of 1891

Not again until 1891 was a general postal subsidy law placed on the statute books. It so happened that, though passed by a Republican Congress, this law was faithfully enforced by President Cleveland's Democratic Administration. It gave us the American Line of transatlantic steamers, still in existence, and it greatly strengthened our steamship services to the West Indies and Australia, even though the rates of compensation provided in the Act were cut down in the House of Representatives to what seemed to be an inadequate figure. The Ocean Mail Law of 1891 commanded the support of a majority of popular opinion, and remained on the statute books until set aside in part by the Merchant Marine Act of 1920.

Though shorn of its full, intended effect by sectional rancor in the National House, this Act stimulated ocean shipbuilding, developed strong shipping services and gave the country in the Spanish War of 1898 and in the great world war the invaluable nucleus of a naval reserve.

Between the Spanish War and the world war there were persistent efforts to liberalize and extend our subsidy legislation. These efforts failed. It will be interesting to review the facts in the case, because the actual records strongly support the assumption that the right kind of a subsidy law could readily be enacted by such a Congress as that now in power in Washington.

Frye Subsidy Bill

In the first session of the fifty-seventh Congress, in December, 1901, Senator William P. Frye, of Maine, chairman of the Committee on Commerce, introduced a comprehensive shipping subsidy bill providing national aid for regular mail lines and granting a fixed subsidy based upon mileage in the foreign trade for cargo steamers and sail vessels.

This measure involved an expenditure of about $9,000,000 a year. It was actively supported by all the shipping interests and a large part of the commercial interests of the country, and it passed the Senate by a decisive majority. But it encountered a hostile committee dominated by Middle Western men in the House of Representatives and could not be reported out of this Committee on Merchant Marine and Fisheries.

Gallinger Subsidy Bill

In the spring of 1904, on the recommendation of President Roosevelt, Congress passed a bill creating a Merchant Marine Commission of five Senators and five Representatives, a majority being Republicans. This commission, headed by the late Senator J. H. Gallinger of New Hampshire, conducted an active inquiry by hearings throughout the United States and reported a general shipping subsidy bill providing encouragement not only for mail lines but for cargo vessels, steam and sail. This measure passed the Senate on February 14, 1906, by a vote of 38 to 27.

As illustrating the increased popular strength of the subsidy principle when properly advocated and explained, the Gallinger bill, amended, however, so that bounties to cargo craft were stricken out, was passed in the House on March 1, 1907, by a vote of 157 to 145. Thus the measure, or a substantial part of it, had won a triumph in both branches of Congress. But the bill unfortunately met with filibustering opposition in the Senate, led by Senator Carmack of Tennessee, who was retiring from public life, and a few weeks later was slain in a street brawl in his home town. This defeat of the Gallinger bill was made possible by the fact that it was brought up in the last hours of an expiring Congress.

President Roosevelt, however, pushed the subsidy bill so vigorously that as an ocean mail measure it was again passed in the Senate on March 20, 1908, without a roll-call—the usual Democratic opposition being withdrawn, very largely out of respect to Senator Gallinger, after the passage of the measure had been earnestly advocated by several Democratic Senators. Three days later, in the House of Representa-

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tives, on a motion to add the subsidy measure to the Post Office Appropriation bill, the vote was exceedingly close, but the motion was defeated 145 to 153. In the following session, on March 2, 1909, a renewed motion to pass the Subsidy bill as a part of the Post Office Appropriation bill was defeated again by the very narrow division of 172 to 175.

Defeated by German Influence

What a difference a victory for the American ship would have made in those divisions in Congress! That Ocean Mail bill of President Roosevelt and Senator Gallinger would have rapidly constructed from thirty to forty large mail and passenger liners, of a speed of from 16 to 20 knots, capable of carrying from 50,000 to 100,000 fighting men in one voyage to the battlefields of France. These ships would have been of immeasurable value as additions to the skeleton naval reserve of the United States. But not even the magic influence of Roosevelt could win against the snaky German propaganda then active particularly in the half-Teutonized Northwest. Mark the States whose Republican votes on May 23, 1908, defeated this measure by the narrow margin of eight votes in the House of Representatives:

Wisconsin	8
Illinois	6
Minnesota	3
Iowa	4
Kansas	3
Nebraska	2

Here are exactly the States where the "German vote" in the United States is strongest, and where Representatives, all unconsciously, perhaps, but none the less effectively, were doing the Kaiser's will.

While these ocean mail-naval reserve bills were before the country, the heads of the great German steamship combinations, the Hamburg American Company and the North German Lloyd, were publishing broadcast in the American press all kinds of adroit protests and appeals against the passage of this American shipping legislation, which President Roosevelt had so strongly urged in fulfilment of the solemn pledges of the Republican platform. The men who chiefly inspired and circulated this propaganda against the American merchant marine were bold enough to do so over their own signatures. One was the late Herr Albert Ballin, the head of the Hamburg American Company of Hamburg; the other the late Emil Boas, agent of the Hamburg organization at New York. This alien opposition of Teuton magnates, who were looking forward to "The Day," was frankly denounced on February 26, 1907, by Chairman Grosvenor of the House Committee on Merchant Marine and Fisheries. General Grosvenor said:

"Two great foreign steamship companies which have bitterly fought the encouragement of American shipping are the Hamburg American Company of Hamburg and the North German Lloyd Company of Bremen, the latter subsidized for $1,350,000 a year for a 15-knot mail service to the East Indies and Australia.

"Both of the great steamship companies owe their wealth and their power largely to the patronage of American merchants and travelers. Yet in the crisis of our war with Spain, in 1898, both companies took fast ships out of the New York service and transferred them to the Spanish government."

General Grosvenor continued:

"The real head and front of opposition in this country to the encouragement of American shipping always has been, is and always will be the rich and powerful foreign steamship companies, most of them subsidized by their own governments. The foreign steamship companies that do not want this ocean mail bill—like the foreign shipowners who monopolize our trade—tell the Representatives of the Middle West that the West has no interest in an American merchant marine; that this bill is only 'graft' for the benefit of New England, New York and Pennsylvania, and that the Mississippi Valley and the prairie States ought to join with this foreign steamship 'combine' and with the subsidized companies of foreign countries to defeat in this House all legislation for the protection and encouragement of the American merchant marine."

At that very time German propaganda was recognized and denounced by the friends of the American ship in Congress. To their credit, be it said, a decisive majority of the Republican Representatives of the Middle West, as a whole, voted for the subsidy measures and for the upbuilding of our merchant marine. But the minority of these Middle Western men, significantly in States like Wisconsin, voted with the almost solid Democratic party, opposed in principle to subsidy, against the measures which Senator Gallinger had framed and President Roosevelt was supporting. In fact, several years later, such was the infatuation or cowardice of these Middle Western public men, that many of the most conspicuous foes of the subsidy bill voted against the declaration of war with Germany!

This Teuton propaganda at the height of its power in Congress was able to defeat subsidy legislation by eight votes out of a total of 298 on May 23, 1908, and by only three votes out of a total of 347 on March 2, 1909. Does anybody imagine that the German propagandists have any such grip now as they had then on Middle Western Republican Representatives from Teutonic districts? Does anybody imagine that the Middle West as a whole has learned no lessons from the great world war of the vital importance of an American merchant marine?

Subsidy Bills Defeated by Slender Margins

On the face of the record it ought easily to be possible for President Harding and his unprecedented Republican majorities in the National House to pass subsidy legislation carefully drawn, vigorous and comprehensive. It is easy to say that subsidy bills were always defeated. As a matter of fact, they were not always defeated, and when they did fail it was by the slenderest of margins. Senator Gallinger—all honor to his memory—could not beat the German propaganda of his time. But he almost beat it, though it was so bold and unblushing that a distinguished Senator from the State of Wisconsin, after attacking with the utmost bitterness the Merchant Marine Commission bill in the Senate, saw nothing wrong in resigning from the Senate and going over to New York to become the general counsel of the Hamburg American Steamship Company, which naturally appreciated such services.

The Germans of the Northwest now have no particular motive to oppose the passage of American shipping bills, for the ships of the Fatherland are few and far between, and it is Great Britain that is our principal antagonist. Moreover, the great war has had its effect upon the Democratic party, which probably could no longer be depended on to oppose subsidy as a whole. It should be said for the Democrats of 1906-1909 that they voted against the subsidy legislation because for a generation they had been in the party habit of voting against it, and not because of the effect of any foreign propaganda or any lack of zeal for the American merchant marine. But the Northwestern Republicans who voted against their party and against their President could proffer no excuse—for these very men were zealous enough to vote the very next day for tariff favors for their agricultural constituents. It happened that I had been serving as the executive officer of the Gallinger Commission at that time, and one of those Northwestern Republicans, a native of New England, actually confessed to me that he had to vote against the shipping bill or the German element at home would defeat his reelection.

Because I know of very direct knowledge what defeated that shipping subsidy legislation, I cannot agree that in these times "no subsidy bill can pass."

The Ship Operator's Interest in Foreign Trade

Our Merchant Marine Should Carry at Least 50 Percent of the Products of American Factories and Farms to Markets of the World

By John L. Binda*

IN those halcyon days for the American merchant marine when our clipper ships were known and seen in all ports of the world and when our merchants made fortunes, which were the foundations for many of the large fortunes of today, by trading in everything that could be exported or imported, the ownership of the vessels and their cargoes was largely a local matter pertaining to those living in the immediate neighborhood of where the ship was built. The merchants, traders, manufacturers and farmers were all investors, while the master and crew shared in the resultant profits.

Interest in overseas commerce was then universal and the ship operator not only occupied himself with the routing of his ship but was also interested in the disposition of the cargo. He often possessed a profound and intimate knowledge of the markets of the world and the economic conditions prevailing therein. Moreover, he understood and appreciated the great element of national service in foreign trade.

In these days of specialization and standardization, however, the operator of ships seem to have restricted his interest to the immediate management of the vessels in his possession. He is neither concerned with the origin of his cargo, nor with its ultimate disposal after delivery to the ports of call. Furthermore he does not realize that every branch of business in the country is dependent more or less upon and tied up in some degree with shipping.

Commercial Opportunities

The commercial benefits of trade and of that understanding between nations which leads to the mutual exchange of products, which protects merchants and merchandise and gives to the trader of other countries, under more or less easy conditions, opportunities for commerce with this country, are very vague to him.

If we were to consider foreign trade in all its aspects, it would involve consideration of every phase of our existence. It is closely interwoven with our politics, our finance, our industry and commerce, our railroads and shipping. It influences and is influenced by every one of our human activities. Foreign trade is the concrete expression not only of our exchange of goods, but to a great extent of our intellectual, personal and institutional relations with other people.

Foreign trade is a study and a science in itself. It is a business founded on principles and determined by conditions that require constant study and attention. It was the knowledge of these facts, and the conformity thereto, that has made Great Britain the great foreign trading nation of the world.

Domestic Market Not Sufficient

The present wave of industrial depression has clearly shown how fortuitous and casual our foreign trade has been in the past. We built a great merchant marine in a few years to carry the product of American factories and farms to the markets of the world. There was a time not far back when the demand from abroad strained the capacity of the mills, the factories and the farms. The stars and stripes were again becoming familiar in every port. The long hoped for day when at least 50 percent of our foreign trade would be carried in American ships was in view.

But what a change has taken place! With the stagnation of shipping, resulting from the worldwide business depression, our merchant marine has been forced gradually to withdraw from the seas. At last the ship operator is beginning to appreciate the vital necessity for the continuous and proper development of our foreign trade.

> *In the United States we have reached the period of industrial development where foreign trade has become distinctly and incontestably a matter of national service. We can no longer afford to depend, as we have depended chiefly for so many years, upon foreign trade merely as an opportunity for the casual disposal of temporary surplus. Our industrial development which has progressed so steadily and rapidly during the last half century reached its climax in the war period. We have attained the degree of production where we must either sell largely and continuously abroad, or endure stagnation and disaster at home.*

At present we are confronted by a situation of exceptional difficulty and though we may not possess the benefit of world-wide long experience of some of our competitors, a proper appreciation of the meaning of foreign trade to the nation and a spread of sympathetic understanding among our people as to the necessity of doing all in their power to assist in its development will brighten prospects for an early amelioration of the present conditions.

Debts Must be Paid by Imports

The liquidation of the tremendous amount of foreign securities held by the Government and investors should be of vital concern to the ship operator. The war turned us from a debtor to the world's greatest creditor nation, and instead of having an interest outgo of $250,000,000 per year, we are entitled, when Europe gets back into condition to produce and pay, to an interest income of nearly $600,000,000 per year. In theory this interest must be paid in money. In practice, however, the debtor countries will pay in goods, materials or in articles which our climate will not allow to be produced or not to be produced in so useful a form.

When a country borrows, it exports securities and takes goods in exchange. In theory the lender provides money; in practice he lends manufactures, rails, rolling stock, ammunitions, supplies, etc. In the early development of the railroads in the United States, the financing was done in England and it was British steel that was used in the construction. During the world war the loans to the Allied countries, although expressed in dollars, actually represented war material and food bought in this country and shipped abroad.

The ship operator will, therefore, realize that there will be for sometime to come an ever increasing flow-back into this country of articles of European manufacture. The importation of these goods instead of money and securities will cause a check of the tendency to increase the amount of currency in this country and lower the value of the dollar. Another result will be that while we can sell abroad goods that we can

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produce to a better advantage, this will be counterbalanced by the importation of other goods which can be produced better abroad.

Imports We Must Have

It is because we have great need of certain materials that can only be satisfied outside our country, that foreign trade is a necessity. Little does the manufacturer of this country realize how dependent he may already be upon foreign countries for the supplies that keep his industry alive. If he is a leather manufacturer, he must import quebracho for tanning from Argentina. If he manufactures anything in which the use of rubber enters, he must see that his business would be impossible but for the importation of rubber from the Straits Settlements and Brazil. Does he manufacture tin plate? Then he must go to Bolivia for his tin. No flax, jute, or sisal—all of which are so important to many of the industries of the United States—is grown in this country and our supply must be obtained from other lands. This list might be extended indefinitely, but it is sufficient to show that in practically every article manufactured in the United States there enters a product of some foreign country, and that, after all, we are as dependent upon foreign markets as upon local markets for the proper development and continuation of even our domestic business.

There is nothing "foreign" about foreign trade, for it is based upon the same principles and is simply an extension of domestic business to which new languages, new points of view, new business methods and new ways of doing things may be added.

No nation can flourish, if the individuals comprising it are not actively employed in profitable occupation, the measure of that profit being the manner of the general weal. A country dependent solely upon the proceeds of the cultivation of a poor soil in an uncongenial climate and the scanty returns of occasional fishing and hunting is fated to remain low down in the scale of civilization and its people are unable to enjoy those advantages of culture, education and refinement common in other lands more richly endowed. It is because this country enjoys fertile soil and a variety of climate and is richly stored with coal, iron and other natural resources that its inhabitants are able to partake of greater advantages than are the inhabitants of the Old World.

Market Price Determined by Surplus

Interest in foreign trade in this country did not extend, prior to the war, much beyond such of our citizens as inhabited a narrow fringe along the Atlantic and Pacific seaboards. It has been hard for the farmer in the interior to realize that the price received for his cereal is largely the price which the surplus portion of his crop obtains in the final consuming market of the world, less expense of transport and sale; that such a price governs not only that exportable surplus but fixes the level at which the domestic portion of his production sells at home.

The necessity for a sympathetic understanding by the ship operator of the problems which confront the farmer in the economic disposition of his produce to the markets of the world is vital. Every step which reduces the expense of transportation also tends to increase the net return on the entire production of his farm. The consuming countries of Europe largely make the measure of the prosperity of our cereal producing regions. Complete and adequate ocean transport, with regular service and fair rates, will directly reflect into the maintenance of the buying power of our farmers.

I think that it was Sir Walter Raleigh who said that the nation which controlled the shipping of the world controlled its trade and in that way the world itself. This may not be entirely true, but it cannot be denied that the control of ocean transportation has been a determining factor in the economic life of a country possessing it.

For many years the transportation of the products of our factories and farms to the overseas markets and the buying back of valuable raw material used in our manufactures has been in the hands of the merchant marine of the European nations with Great Britain as the dominating factor. In 1914 our total tonnage in foreign trade was less than two and one-half percent of the world's shipping. The five billion dollars which we owed to Europe at the outbreak of the war was largely resultant from our lack of foresight in not having developed an adequate merchant marine.

Subsidy Has Gone to Foreign Ships

Owning few ships we have been obliged to pay to the foreign ship operator nearly twenty cents on the dollar in freights to send our goods to the foreign markets and another twenty cents had to be added onto the cost of everything bought abroad for transportation to this country. This added handicap has made it comparatively difficult for us to compete on an equal basis in foreign markets with our greatest competitor, which has had the advantage of being able to add to the national income of her subjects twenty cents on every dollar received for the transportation of the commodities entering into our international trade.

We are now in possession of a merchant fleet sufficient for the needs of our international commerce and there is no reason why the ship operator should not be able to retain in the United States a great proportion of the tremendous amount annually paid foreign shipowners for transportation. To do this he must have an intimate knowledge of the fundamental principles involved in foreign trade. He must become aware of the many benefits which its steadfast maintenance brings not only to himself but to every man, woman or child engaged in a productive capacity, for the wide outlets of world trade serve to maintain a steady flow of output, which in turn stabilizes the job of the worker.

Diesel-Electric Yacht Guinevere Successfully Completes Her Trials

EDGAR PALMER'S yacht *Guinevere*, which has just been completed at the yards of George Lawley & Son, Neponset, Mass., successfully passed her trials on August 15. Designed by A. Loring Swasey, the *Guinevere* is a three-masted schooner with a waterline length of 165 feet, overall length of 195 feet, beam of 33 feet and displacement of 642 tons. Her chief feature of interest is, however, her auxiliary power, which is of the Diesel-electric type.

Her power plant consists of two six-cylinder, 350 horsepower, model 24-A Winton oil engines of 225 revolutions per minute, each of which is directly connected to a 225 kilowatt, 125 volt Westinghouse direct-current generator. Power from these generators is supplied to the Westinghouse propeller motor, which develops 550 horsepower at 250 volts and 220 revolutions per minute.

On her trials the *Guinevere* ran over the 6¼ nautical mile measured course between Boston Light and the lightship, attaining a speed of 11.82 knots, which is a knot more than contract speed. At no time did the propeller speed exceed 180 revolutions per minute, and since the propeller motor is capable of 220 revolutions per minute the *Guinevere* has plenty of excess speed.

Special tests made to determine the ability of the vessel to reverse gave the following results: Time to reverse the propeller motor from full speed ahead, 3 seconds; time to effect astern movement of vessel from full speed ahead, 25 seconds; time to effect ahead movement from full speed astern, 15 seconds. During these very severe tests, the motor and generator showed no sparking or signs of overloading.

The reliability of the electrical equipment and the high speed obtained, as shown by these tests, emphasize the practicability of Diesel-electric drive for commercial service.

The Shipping Board Gets Its Chance

By Waldon Fawcett

The 'new management" at the United States Shipping Board has been given until January 1, 1922, to work out its own salvation—to show what it can do to bring order out of chaos. It must accomplish its rehabilitation (if it can) on a "deficiency appropriation" for the last half of 1921 that is much below the estimates submitted to the Congressional committees on appropriations. But in voting an operating fund of $48,500,000 Congress showed a disposition to allow Chairman Albert D. Lasker, the new head of the Shipping Board, to make a test of his policy without imposing undue limitations or restrictions.

NOTWITHSTANDING the conditions at the Shipping Board revealed to Congress in the past few weeks, Chairman Lasker has disavowed any intention to discourage the Government and the national legislature with respect to its merchant marine. On the contrary, he has insisted that some one must show confidence in the American marine, if it is to triumph, and that some one can only be Congress. The Shipping Board fleet, in the time it was operated, "saved to America untold millions of dollars in freights that would have gone to other countries," according to the retrospect of Chairman Lasker, and in the years to come the United States must have an adequate merchant marine or it might as well put an end to its army and navy. It will, he prophesied, require a year "to show anything" and two years to show any efficiency in the rehabilitation of the government-owned merchant fleet but, if every element in the nation is helpful, "the wreck can be turned into an asset so great that from a money value it will be worth the whole $26,000,000,000 that the war cost us."

System of Operating Ships to Be Revised

In shipping circles, interest in the new program of the reorganized Shipping Board will focus most sharply upon the revision of the system of ship operation. And it is here, as it happens, that the manifestation of readjustment has been most radical and most immediate. In effect this involves a divorcing of the detail of operations from the direct responsibilities of the Shipping Board. When the new executives took charge they were appalled by the system which referred every administrative detail of ship operation to headquarters. At one of the early meetings the Shipping Board expended four hours in discussion of one little detail that, as the members afterward confessed, would, in any minor business, be left to a subordinate.

Such a system, it is now felt, shows a faulty perspective on the responsibilities that the law assigns to the Shipping Board. The main function of the Shipping Board and the permanent function, if the Shipping Board is to continue in existence, is to exercise certain regulatory functions over American ships and over all ships touching at American ports, very much as the Interstate Commerce Commission exercises supervision over the railroads and railroad traffic of the country. To this primary duty was added, as the occasion of war required, the operation of the merchant vessels owned by the Government. The result of a literal application of this latter obligation is that whenever a vessel was to be reallocated or when a change of registry was in contemplation the detail was laid before the chief executives. There was neither time nor energy left for the proper consideration of broad questions of policy.

Shipping Board to Shape the Policies

To bring emancipation from this burden of detail is the object of the current change in policy which places the operation of the vessels under the Emergency Fleet Corporation. The members of the Shipping Board are the trustees of the Fleet Corporation and thus they are in a position to exercise the full supervisory powers with which they are vested by law. Yet there will be that decentralization of authority, the lack of which in the past has resulted in that tardiness of decision which passed for incapacity and which when it impeded the announcement of rates on cargo resulted in losses estimated in the aggregate at millions of dollars.

The backbone of the new system of ship operation is found in a trio of new executive positions whose occupants are answerable directly to the Shipping Board. Operating vice-presidents, they are designated, these new managing directors in charge of operations. These vice-presidents, all men of wide practical experience in the shipping field, carry out the policies formulated by the members of the Shipping Board, acting as trustees, and they are of course answerable to the trustees. The operating vice-presidents have plenary powers—the first time that there has been any such delegation of authority under the organization of the Shipping Board.

Actual Operating Plans in Experienced Hands

Determination to bring about operating conditions that would compare favorably with the corresponding status in the sphere of private shipping was indicated by Chairman Lasker's initial selections for the vice-presidential berths. The appointees, W. J. Love, E. J. Frey and J. B. Smull, were selected after a careful canvass of all the executives in the shipping business who might fittingly be drafted for such service. Mr. Frey was for years assistant to the president of the Pacific Mail Steamship Company but he was associated with the Shipping Board all through the war. W. J. Love, eulogized as "one of the few American managers, American born," was formerly with the British shipping firm of Furness, Withy & Company. J. B. Smull is a member of the ship brokerage firm of Winchester & Company. Messrs. Smull and Love were members of the charter committee of the United States Government during the war and thus obtained unique experience through the allocation of all vessels under the American flag used for merchant marine purposes during the war. This trio of experts on allocation and charter are bringing to bear their combined judgment and experience to draft a successor to the M O 4 charter, or contract—a new form that will result automatically, so to speak, in the filing of a report on every voyage.

Just here, it should be noted that managing operator's contract No. 5, supposing it to be distinguished in that manner from the four preceding contracts or agreements, does not presume to wipe the slate clean and start anew the entire program of ship operation. Chairman Lasker has stated that unsatisfactory as is the five-percent-gross-revenue system it is not proposed to scrap it ruthlessly until there is something better to substitute. Moreover, the present condition of the shipping business—the reported impossibility

of making bare boat charters, etc.—has convinced the new head of the Shipping Board that this is not a time to revolutionize the operating system at one stroke.

Warning, he gives, though, that the minute world trade revives so that vessels may be operated at a profit it is the intention of the Fleet Corporation to compel interests that have continued to operate under the M O 4 contract to either purchase the ships in their possession or else enter into new contracts on a basis more favorable to the Government. Otherwise the vessels will be transferred to other operators who will buy or will make charter on a basis deemed to be more equitable to the Government. But the new administration is determined to put an end forthwith to practices on the part of operators such as the routing of ships without regard to the interests of the Government, so long as a profitable commission be assured to the operator, and "side line" enterprises, such as the organization by ship operators of stevedore companies, the excessive charges of which are approved by the interested ship operators.

Ship Repair Accounts to Be Kept Up to Date

A reform is also slated at the Shipping Board in the auditing of repair accounts, the delays in the past being charged largely to managing operators. By former practice it was the custom of the repair companies to submit their bills to the vessel operators for approval. In many instances, the operators did not pass the bills along to the auditing department of the Shipping Board for weeks or months. The auditing is just beginning to get up to date on repair accounts and in the payment of back bills. During the past few months appreciable progress has been made in this direction and it is believed that with the revised routine, which no longer requires the submission of the bills to the managing operators, it will be possible to keep matters up to date.

Director of Operations J. B. Smull took up his new duties in Washington convinced that it was necessary to change entirely the method of operating boats. In this he held to the idea that ultimately all the vessels should be sold. The Shipping Board or the Government should, just as soon as possible, get out of the business of vessel ownership. But there is no present possibility of selling boats at any price and while awaiting a sale market a new form of charter, which will probably be of the bare boat type, is being worked out by the Shipping Board. A committee of the American Steamship Owners' Association will also draw up a form of charter acceptable to the shipowners for the guidance of the Board.

Director Smull's Recommendation

It is conceded that the present is not an opportune time for bare boat charter or sale but, if it is impossible to persuade enough operators to co-operate with the Shipping Board and take some of the risk of operating, the director of operations will recommend that the boats be tied up until such time as it is possible to allocate them upon a basis more favorable to the Government. This will be the recommendation, even though it might increase the immediate loss to the Government to tie up the boats. Director Smull was willing to go further and recommend cancellation forthwith of the contracts in force and the substitution of some sort of co-operative plan. Chairman Lasker concurs with his associate in the feeling that, even though it costs more to tie up the loss-taking vessels than to operate them, this course should be pursued for its effect upon the operators. He feels that, if operators find that they cannot have vessels under the ultra favorable terms that have prevailed in the past, they will negotiate with the Shipping Board on terms less one-sided. All the while, however, Chairman Lasker insists that the 5-percent-gross-revenue contract is really detrimental to the best interests of the ship operating class as well as to the Government. Nobody has any pride in the boats, he declares, and insists that a merchant marine can never be built up in the way the nation has been going. "The old contract system," insists the chairman, "is the worst thing that could happen to the shipowners of America. It does not create stability and it would mean more to the shipowners than it would to the Government to change that system."

Firm is the faith of Director Smull that under a different plan of operation between the Shipping Board and the ship operator the operator will eventually own his boat outright. Especially is the new director confident that co-operation of this kind would be the means of developing profitable new trade routes. Discussing this aspect of the matter the other day, he said: "There are routes that can be developed that Americans have never touched at all. Their scope of business has been too small to allow them to do it.

American Steamship Operators Widening Their Field

"They have been brought up in the Western Hemisphere business or in running to South America or along the coast and they have never broadened. The American steamship man before the war was a rather narrow-gaged man who just ran in the route his father ran before him, or that his grandfather ran before him; but the war came along and it has developed in the American steamship operator the desire for world trading and he is going into it. You have seen in the last two years, or since the war has been over, that these men are spreading out in all directions. The routes that they have not tackled are the routes that they are afraid to tackle and I think it will be advisable for the Shipping Board to help them."

It is admitted that it will take some time to work out a satisfactory operating system and it may be that there will needs be several plans, or modifications of the standard plan, in order to afford suitable conditions for the various classes of ships. Director Smull is set, however, on some plan whereby the operator will accept some of the responsibility for the losses as well as for the profits. He argues that a ship operator should have something at stake so that he will be vitally interested in the operation of the boats; so that, as the director illustrated it, the shipping man will be vitally interested in the question of whether it costs $30 or $50 for a tug to take the boat out of the pier.

One of the ambitions of the new management at the Shipping Board is to do its full share to make vessel operation profitable. All routes are to be carefully inventoried in a determination to ascertain if any routes are over-tonnaged and to cut down the allotments of vessels so that the ships on each route will pay, or at least that losses on parallel lines will be avoided. The new administration will, in the case of all M O 4 contracts that may be continued, overhaul the system of purchasing food and rations that have been in force in the past. Commenting on the record of the past and expressing hope for the future, Director of Operations Smull recently remarked that the fiasco was not, perhaps, the fault of anybody in particular so much as it was the fault of a system. "Practical men must be put in charge" is his slogan for the forward march and it means that not only will practical men sit at the desks at Washington but that each "branch office" where contact is established with the shipping community will be in charge of an executive who has had shipping training and experience.

Electric Lanterns for Oil Ships.—The Standard Oil Company has recently installed in the pump rooms of their oil ships, several hundred LaFrance fire and explosive-proof electric lanterns, manufactured by the American-LaFrance Fire Engine Company. The adoption of this lantern was considered advisable due to the inflammable nature of the air where they are to be used. A new front arrangement, makes possible quick change or replacement of the glass lens or the lamp bulb without using a screw driver or other tools.

Developments in Marine Insurance

Insurance Certificates—Insurance Rates—Theft and Pilferage — Load Line — Bunker Fires

By "Bordereaux"

THERE is a rueful truism current among marine insurance men to the effect that their business is the first to feel the pinch of hard times and the last to recover from it. By which they mean that when trade slackens insurance immediately begins to wane and only feels the touch of revival after productive industry has had its hour's head-start and the underwriter is finally called in to guarantee safe passage for the output. The present period of slump and reconstruction is, therefore, being accepted with grim philosophy; and the underwriter has need of all the constancy he can command.

Not in many a long year has marine coverage been so little in demand, nor have many men now in the business known a time when losses were heavier or the moral hazard more formidable. Ask them "How is business?" and you will be answered: "There ain't no such animile." Barring a hull here and there and an occasional bulk or general cargo, there is little enough to insure. The point is that these are the kind of times that put underwriters to the acid test.

The solid, established offices will know how to weather the storm but the newcomers are flying distress flags. These latter were attracted to the business by the tremendous profits derived from covering war risks. For a time they did a land-office business and piled up fortunes almost over night, but with the return of normalcy they were dismayed to find themselves suddenly bereft of exorbitant revenues and now, with nothing but cold, straight marine insurance to fall back upon —and but little of that—their inexperience has small chance in a contest with the skilled veterans. Many of them have already given up the struggle and more of them are bound to do so.

The effects of this ill-starred invasion of so intricate a line of work have been disconcerting even to the old-timers. The market has been disrupted by desperate efforts to recoup through suicidal rate cutting and the concession of unprofitable coverage conditions. Claims have been side-stepped by the novices whenever and wherever they could manage it. And, to make a bad situation worse, foreign reinsurers have frequently left them in the lurch. However, the worst is well over and the market is shaking itself into shape.

Marine Insurance Certificates

PERHAPS the most disconcerting occurrence of the year has been the decision by Justice McCardle, of the King's Bench Division of the English High Court of Justice, to the effect that a marine insurance certificate is not the same thing as the original policy and may not be substituted for it. This dictum, if given wide acceptance, would strike a mortal blow at the most convenient and labor-saving device now employed in this business.

The certificate applies only to cargo shipments. It originated in this country and has been in highly satisfactory use for more than a half century. Foreign insurance companies domiciled here make free use of it and a number of foreign countries have adopted it. In this country at least it has largely replaced the insurance policy itself as the document used in financing commercial transactions. The general practice now is for merchants to take out open policies for the protection of all their shipments over certain described routes and under such policies the assured is given the privilege of issuing certificates on special forms.

These certificates, when properly countersigned by some authorized representative of the company, afford a convenient way of issuing negotiable evidences of the insurance itself. They have always been acceptable to the banks and make one of the four documents which collectively are known as a "commercial set"—namely, the invoice, the bill of lading, the draft or bill of exchange and the insurance certificate. They provide for payment in all parts of the commercial world and, when issued by responsible underwriters, are accepted at their face value in every banking center everywhere. This insures additional promptness in the payment of claims, as foreign settling offices are under no necessity of forwarding documents to the original issuing company.

The point made by Justice McCardle is that the buyer can not know that the certificate is of proper character unless he examines the original policy and that he could not sue under it unless he showed that he is the assignee—which is something, in his opinion, unprovided for under the Marine Insurance Act of 1906, the controlling law of England with respect to marine insurance. This decision, it must be admitted, shook the American marine insurance market up considerably, but sober second thought has restored its equanimity. Much of the force of the Justice's contentions is lost by the fact that the very certificate in question is found to have contained all clauses necessary to inform its holder of the conditions of the insurance on the particular shipment which it covered. The real reason that England does not herself employ certificates is because her laws require the imposition of a stamp tax within ten days of the arrival of a shipment in her ports; this tax has to go on the original policy. No reputable American underwriter has ever repudiated its certificates, whether they carried the British stamp tax or not. England has no open policies, but it has what is practically the same thing, a "perpetual cover."

The American Institute of Marine Underwriters has had the McCardle decision under consideration, but it is improbable that any especial action will be taken. The whole matter, it is confidently believed, will soon blow over.

Insurance Rates

THERE has been a deplorable tendency on the part of American shipowners to bring all the influence they can control to bear upon a reduction in insurance rates. Only last June the managers of the American Marine Insurance Syndicates granted a reduction of from 15 to 20 percent on all Syndicate "B" boats, and they feel that they can go no further without inviting certain loss to the subscribing companies.

The reason for unrest on this point on the part of our shipowners is the wide-open condition of the London hull market. When the British Hull Agreement collapsed, two or three months ago, it threw rates, values and conditions into a welter of chaos and Lloyds and many of the more greedy company underwriters flew at one anothers' throats in a mad scramble for business at any old price. The natural result has depressed insurance rates to a losing basis—but it has presented shipping interests with the greatest bonanza they ever had over there.

The effect of this was at once felt by shipowners on this side and that is why they would like to see something of the same sort in vogue here. It would bring their insurance

overhead nearer a competitive equality with that of their foreign rivals. But fortunately for the stability of American marine insurance the majority of the board of managers of the Syndicates have set their faces firmly against any such suicidal recourse as a rate war with their desperate British competitors.

Bunker Fires

BUNKER fires continue to cause a consistent run of losses. Underwriters urge close attention to the problem of proper care for the stowage and watching of bunker coal, as they have been compelled to charge this hazard with a very considerable increase in marine casualties. It is found that certain varieties of new coal, much of which is untested, have been employed to fill out shortages caused by the recent British coal strike and that spontaneous combustion has frequently developed in them. Excessive heat, so generated, extends to coal in permanent reserve bunkers and releases gases which readily become ignited. The chief causes of bunker fires lie with the regrettable tendency to slight the cleaning out of bunker waste, which accumulates in the form of coal dust and forms dangerous pockets.

Theft and Pilferage

OF all the alarming consequences of the late world war the most serious to marine insurance has been the enormous increase of theft, pilferage and short delivery claims. This has come about through an undermining of moral fiber and a disregard for property rights, combined with a suspension of discipline among transportation workmen, whose services were so all-important during hostilities, and a subtle change in the relations of shipowners, shippers and underwriters.

The risks of theft and pilferage, which may be described as the stealing by stealth of goods while in the custody of third parties during the process of transportation, are not covered by a marine insurance policy unless provision therefore is made by special endorsement. They are not properly marine perils and the underwriters should not insure them at all. They drifted into doing so during the war as an accommodation to their patrons. Prior to that the burden of this hazard had rested upon the steamship companies; but under stress of war conditions the latter became virtual dictators in overseas commerce and shifted the responsibility to the shoulders of the underwriters by introducing clauses in their bills of lading which negatived in large measure their common law liability for property in their custody.

This led to a relaxing of vigilance in the safeguarding of shipments and the evil grew by leaps and bounds. It has extended to every part of the world. Underwriting offices have been swamped under an endless deluge of claims and the situation is as bad today as at any time since the war. Better packing has been effected and advertising matter removed from shipping cases—thus doing away with two fatal avenues of criminal approach—and shipping marks have been regularly changed to mystify the thieves; still the losses continue to mount up. Remedial devices, in the shape of new policy clauses, have been tried without success both here and abroad.

So great has become this menace that the attention of the national Government has been called to it, and the House committee on the Merchant Marine and Fisheries has under consideration the advisableness of amending the Harter Act so as to restore to it the force originally intended by its framers and place responsibility for goods in transit upon the shoulders of the carriers. This movement is receiving the unanimous support of marine underwriters. They contend that the original Act has been made largely non-operative through numerous amendments, State statutes and court decisions and that, in consequence, carriers are today able to limit their liability to negligible amounts. The weakness of the Act is that it limits the scope of the carriers' liability, but not the amount of it. The old Act of March 3, 1851, on which rests the principle of American maritime limitations, imposed a much more strict account. The Harter Act, which was passed February 13, 1893, fixed no new obligations upon the shipowner, but, on the contrary, accorded him exemptions he had never had before. A leading authority in admiralty law has pronounced it "the great bulwark of the foreign shipowner—in fact, of all shipowners—in contesting liability for cargo losses."

Load Line

THE reconvening of Congress brings up for final decision the question of America's having a load line. Marine underwriters are solidly behind the affirmative. They argue that the United States stands practically alone among the great Powers in being without this safeguard to marine life and property, and that there can be no valid contention against it that is not grounded upon selfishness. They insist that their advocacy of the proposal does not arise from selfishness, as they would only have to raise the premium rate to equalize adverse conditions; but they feel that America, without a load line, is in a disadvantageous position with respect to other nations—having no reciprocal demands to impose—and that the lives of American seamen are imperiled for want of it. Leaving the loading of a vessel to the discretion of a master or captain is regarded by them as a hit-or-miss method of less than doubtful value. Furthermore, a scientifically ascertained and imposed line puts the conscientious and careful shipowner on a competitive equality with his less scrupulous competitor, who, with an identical overhead, may now out-operate the former by carrying more cargo.

Under the provisions of the proposed bill the determination of our load line would rest with the Secretary of Commerce, and a commission appointed by him has reported a line that has an advantage over the British Plimsoll marks in that it is made from the viewpoint of America and American trade. Underwriters predict that such a line would result in the lowering of the insurance rate, because the loss on boats would probably be less. They also feel that our national position would be immeasurably enhanced, if we have a definite plan of this kind in operation, when we enter the international load line conference that is certain to be held in the not remote future. We could then enter such a conference with a worked-out, well-working plan of action, rather than have to accept and make the best of some foreign proposal specially adapted to the needs of other interests and conditions than ours.

Rates via the St. Lawrence

QUESTIONS are frequently raised as to the probable effect upon marine insurance rates of the carrying through of the project for the St. Lawrence inland waterway, particularly as it would concern an all-water route from Duluth via Montreal to the United Kingdom. A comparison of rates as at present obtaining on, for example, grain shipped from Duluth all-water to Montreal and thence to the United Kingdom, with the same commodity shipped over the lakes to Buffalo and thence by barge canal to New York for transshipment to the United Kingdom shows a differential during the summer months of about 10 percent in favor of the latter route, with a rapidly increasing differential in favor of the New York route from October 15 to the close of navigation out of the St. Lawrence. The summer differential might be practically wiped out, if there were a direct all-water route via Montreal eliminating the transshipment which now occurs at Port Colborne or Kingston.

The present basic transatlantic rate out of Montreal is practically double that of New York; this is because Mon-

(*Continued on page* 778.)

Marine Exposition a Combined Maritime Gathering

National Marine League Unites with Society of Naval Architects and Marine Engineers and Marine Equipment Association, Navy Department and Shipping Board to Exhibit and Co-operate

CONSIDERABLE progress has been made by the Marine Equipment Association of America in its plans for "American Marine Week"—November 14-19; and everything points toward this as the greatest single event of its kind in the history of marine shows.

At a meeting of the Executive Committee of the Association on September 19, a number of matters were decided, the one of first importance being the unanimous acceptance of a proposal for complete co-operation with the National Marine League submitted by its president, P. H. W. Ross, in person at the meeting. In substance, the agreement provides ways and means for uniting the efforts of the two organizations in the matter of stimulating public interest in a real American merchant marine.

Chairman Wampler of the Exhibit Committee reported that notwithstanding no concerted effort has as yet been made to sell exhibit space, applications had been received from a number of concerns aggregating something like one-third of the total number of square feet available and that the outlook was decidedly favorable.

Registration and Badges

The question of badges for members and guests who attend the exhibition was then brought up. A design was approved; and it was decided to provide distinctive colors for members, guests and ladies. In an effort to expedite the work of registration, an advance canvass will be made among the members of the Society of Naval Architects and Marine Engineers, American Society of Marine Draftsmen and other like organizations in an effort to learn who will either attend the annual conventions of their respective associations or be in New York during "American Marine Week." Further, beginning on the morning of the second day of the exhibition (November 15) printed lists will be distributed each day, containing the names, badge numbers, occupations and New York City addresses, if any, of all those to whom badges had been issued up to closing hour on the night previous. All names will appear, both alphabetically and numerically, so that one can tell at a glance whether a certain person is registered as attending the show, and be able to identify him at sight by his badge number if unknown to the user of the list. While the idea is not new, printed lists of that kind having been used continuously at conventions in the steam railway field for some twenty years, this is the first instance where any like attempt has been made in the marine field. Not only are lists of the kind valuable as permanent attendance records, but when used on the ground in connection with the numbered badges, they contribute much in bringing together those who design, build, repair and operate ships and those who manufacture and sell.

Owing to the absence of the treasurer of the association on vacation and the necessity for having a disbursing officer located in New York City, H. C. Davis, of Row & Davis, Engineers, Inc., was appointed acting treasurer.

The businesslike way in which the Marine Equipment Association is operating is reflected in a series of nine bulletins which have been mailed to all prospective exhibitors. No. 1 gives full information about membership dues, rates for space and payments therefor and a lot of detailed information about exhibits and their limitations, to which are attached a floor plan and an application for space. Bulletins 2, 4, 5, 6, 7 and 9 cover various subjects of interest to exhibitors, including very complete information about shipping and setting up exhibits; while Bulletins 3 and 8 contain advertising suggestions and information about free admission tickets. The information given is so complete as to leave little room for imagination and thus the necessity for questions by prospective exhibitors is reduced to a minimum.

All Marine Associations Invited

It was decided to issue invitations to attend the exhibition to all members of the several associations in the marine field who have not yet formally agreed to co-operate with the Marine Equipment Association, including such bodies as the American Steamship Owners' Association, United States Steamship Operators' Association and Maritime Association. The Atlantic Coast Shipbuilders' Association through its secretary, Clarence Samuel King, on September 22 wrote to the Marine Equipment Association as follows: "We will be very glad to co-operate with you in this enterprise and towards that end offer you the facilities of this office in distributing tickets, invitations and any publicity matter which you may care to place in the hands of our members."

Further, the International Conference on the Limitation of Armament will be in session at Washington during the week of the marine show. It is estimated that several thousand men from all parts of the world will come to America because of the conference; and many of them have to do with ships and shipping when at home. Efforts will be made to get as many of the latter as possible to come to New York during "American Marine Week." Also, engraved invitations to review the exhibition will be sent to all foreign naval commissions and naval attachés to foreign embassies in this country.

Publicity Committee Appointed

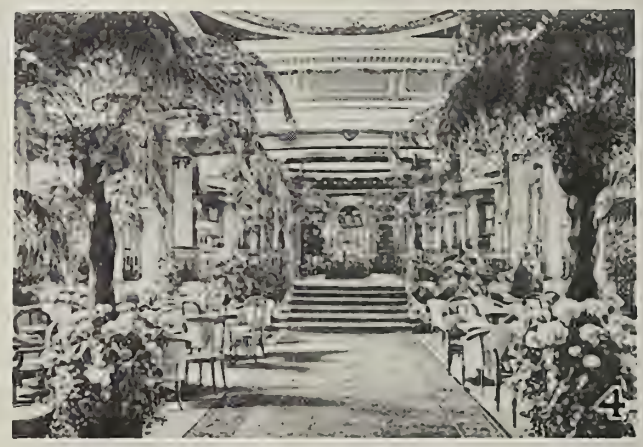
President Simmons announced the appointment of a Publicity Committee, consisting of William A. Cather, Worthington Pump & Machinery Corporation, chairman; K. W. Heinrich, Bethlehem Shipbuilding Corporation, and C. H. M. Jones, Todd Shipyards Corporation. Also J. D. Sarles, Pyle-National Company, was made chairman of the Membership Committee, the other members of which will be appointed later.

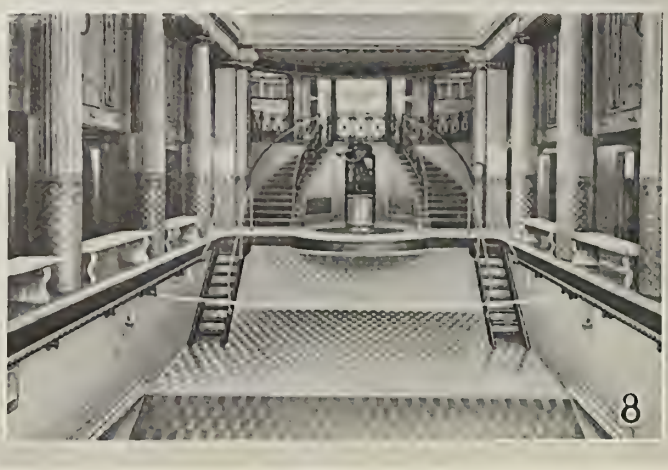
On September 20 the joint committees of the Society of Naval Architects and Marine Engineers and Marine Equipment Association appointed by those bodies to agree on a joint program for the days on which the former organization will hold its annual convention (November 17 and 18) met at the Engineers' Club. Captain C. A. McAllister, chairman of the committee appointed by the Society of Naval Architects and Marine Engineers, presided. The others who attended the meeting were J. Howland Gardner, W. H. Todd and F. L. DuBosque of Captain McAllister's committee, and W. A. Cather (representing chairman M. L. Katzenstein), A. J. Barnes, Major F. C. Cheston and Colonel E. A. Simmons (president of the association, ex-officio) of the Marine Equipment Association committee.

Taxicab Service to Exhibition

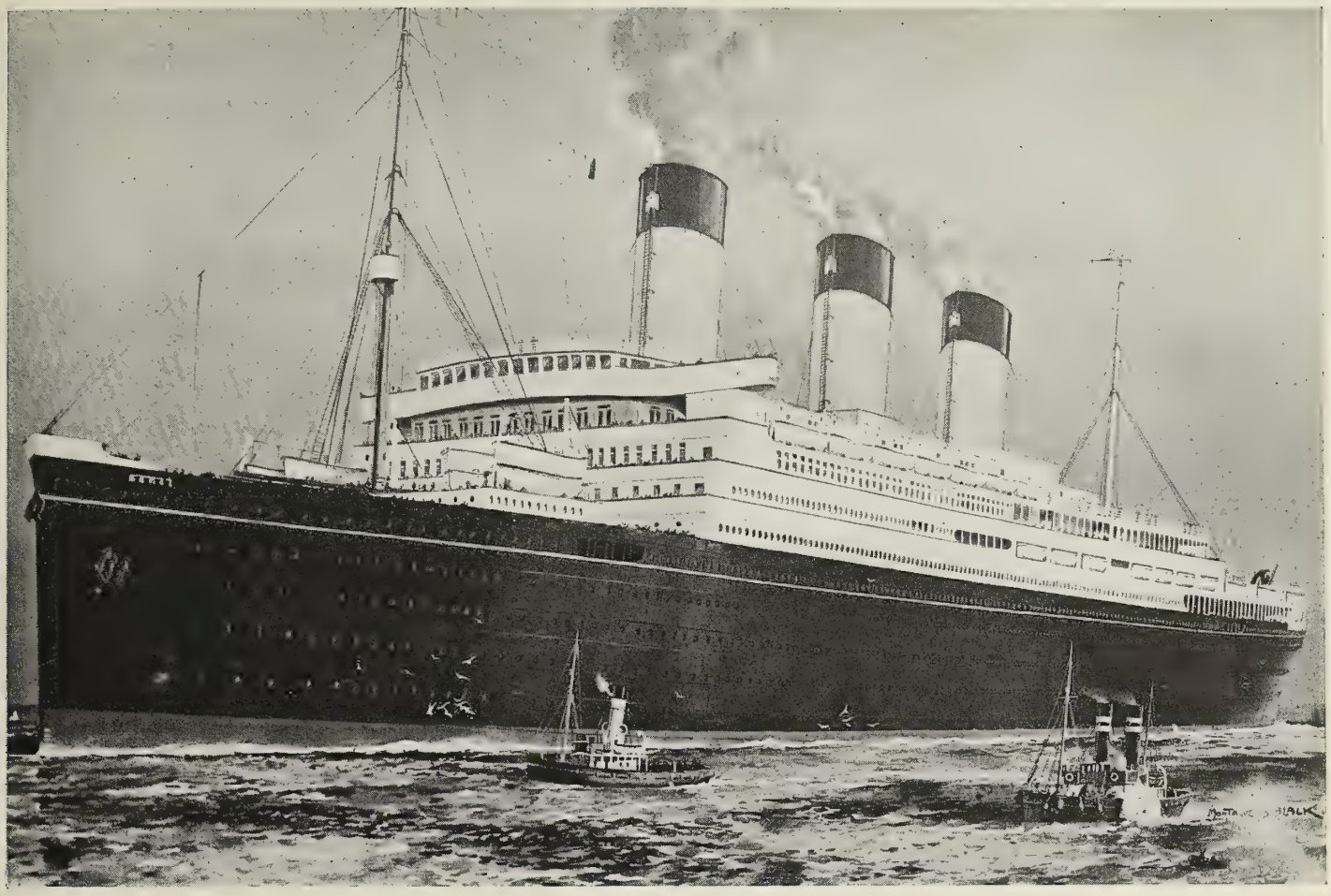
It was decided that the joint committee had no jurisdiction whatever over the dinner scheduled for the night of November 18, that function being entirely within the control of the Society of Naval Architects and Marine Engineers. The question of entertainment for the ladies was left in abeyance pending receipt of information as to the possible attendance.

(*Continued on page* 738)





S. S. Majestic: Interior Views of First-Class Accommodations. (1) Lounge. (2) Dining Saloon. (3) Ritz-Carlton Restaurant. (4) Palm Court and Entrance to Ritz-Carlton Restaurant. (5) Reading and Writing Room. (6) Stateroom en Suite. (7) Smoking Room. (8) Swimming Pool.



Sketch of the Majestic, the World's Largest Steamship, as She Will Look When Completed

White Star Liner Majestic

Largest Ship in the World Rapidly Approaching Completion at Hamburg

REPORTS recently received at New York by the International Mercantile Marine Company from the representatives of the White Star Line, who are supervising the completion at the yards of Blohm and Voss, Hamburg, Germany, of the 56,000-ton liner *Majestic* (ex-*Bismarck*), the world's largest ship, show that work is being pushed steadily on the mammoth vessel and that all indications point to her readiness for service between Southampton and New York next spring.

Despite the disturbed conditions in Germany, there has been no interference with the progress of work on the *Majestic*. Representatives of the White Star Line and of the German builders are working together to complete the ship which, in accordance with the terms of the peace treaty, will leave Hamburg as a finished product except for the outfitting with stores and minor equipment.

On taking her place in the New York-Cherbourg-Southampton service of the White Star Line, the *Majestic* will conform in the details of her passenger fittings to the standards established by the *Olympic*, with which she will ply in that service. As to size, however, she will stand alone since she is nearly 10,000 tons larger than the *Olympic* and about 2,000 tons larger than the *Leviathan*.

The hull of the *Majestic* conforms to the usual form above the waterline combined with the form of a warship of modern construction below the waterline. This was adopted as the most economical form of hull after careful model tank research work with five separate models in two different experimental stations, and represents the form of the last model which showed a saving of more than 17,000 horsepower in addition to a considerable increase in stability over the first model, these advantages being due to an alteration in the after body of the vessel for which the cruiser shape below the waterline was adopted.

Hull

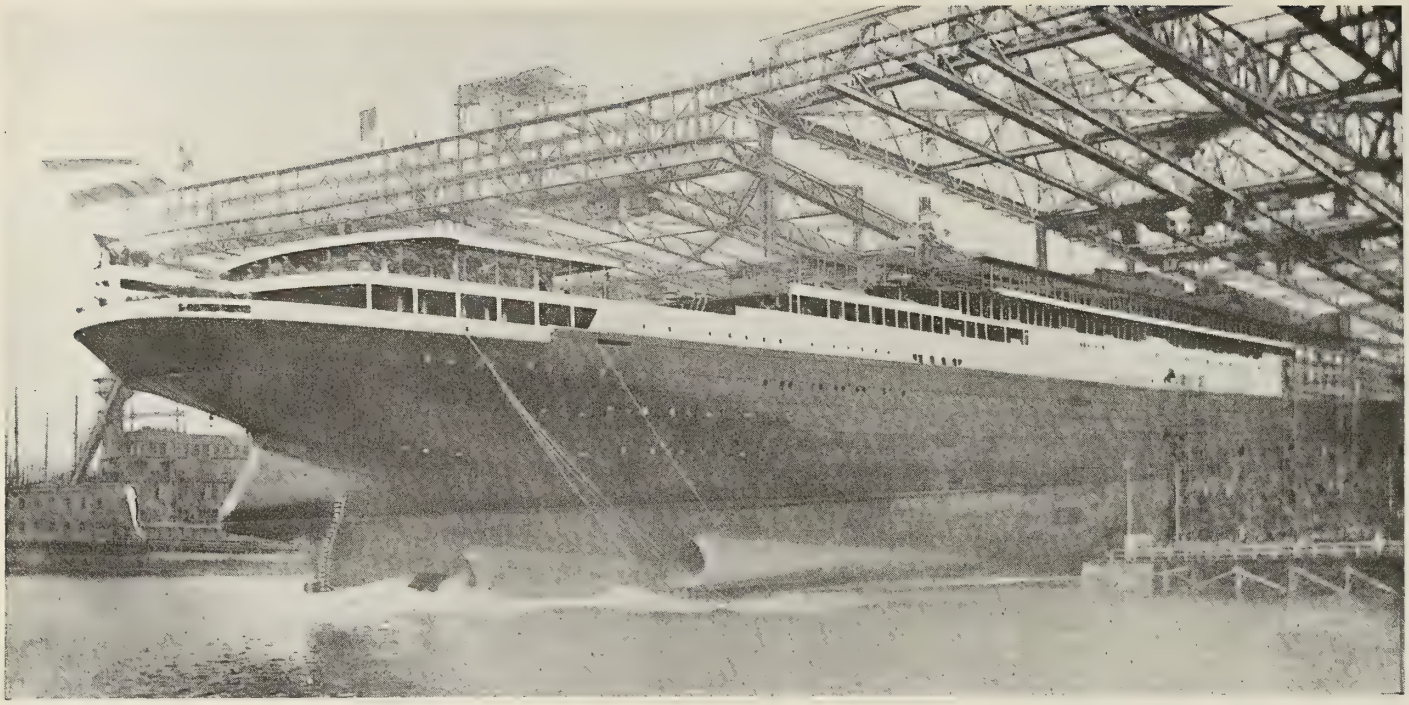
The principal dimensions of this gigantic vessel are as follows:

Length overall	955 feet 9 inches
Length between perpendiculars	915 feet 9 inches
Breadth, molded	100 feet 0 inches
Depth, molded to D deck	70 feet 4½ inches
Draft, loaded	38 feet 6 inches

There are five steel decks running the full length of the hull and four superstructure decks in the center third of the hull.

The hull is subdivided into numerous watertight compartments connected by heavy doors that can be opened and closed quickly by hydraulic pressure electrically controlled.

Some of the miscellaneous items aboard the ship for which information is available and which will tend to show the massiveness of the vessel are as follows:



Launching of the Majestic. The Photograph Shows the Novel Form of the Ship's Stern At and Below the Waterline

The bow anchors weigh 15 tons each and the smaller anchors 10 tons each.

One chain cable for anchoring the vessel weighs 230 tons.

Wireless equipment of varying power is installed in three storage wireless stations on board and the ship will maintain constant touch with both Continents throughout an Atlantic voyage.

Safety devices against fire include deck coverings of composition capable of resisting the fiercest blaze and the glass in doors will resist 2,900 degrees of heat. Smoke detecting devices in various parts of the ship and 1,200 fire alarm points of which 450 are automatic connect with the central station.

A complete telephone system connects all parts of the ship.

The ventilating ducts throughout the vessel, which provide for constant changes of air, have a total length of 98,000 feet.

The height of the vessel from the keel to the boat deck is 102 feet and the smokestacks, of which there are three, are 30 feet in diameter, the tops being 144 feet above the waterline and 184 feet above the keel.

The topmost crow's nest on the foremast, reached by means of a ladder inside the mast, is 180 feet above the water and is the loftiest perch ever carried on a steamship.

Communication between the nine decks is facilitated by electric elevators, one of these being fitted in the engine room.

Accommodations

The accommodations aboard the *Majestic* provide for the carriage of 5,200 people, 4,100 of these being passengers and 1,100 crew. The first class accommodations provide for 1,000 passengers berthed in 472 staterooms; 700 second class passengers berthed in 212 staterooms and 2,400 third class passengers berthed in 561 staterooms and inclosed dormitories for single men and single women.

The staterooms range from a neat little one-bed room for a single traveler to elaborate suites of a half dozen rooms each with parlor, private sun veranda, dining room and bedrooms with private baths.

First, second and third cabins are each provided with separate galleys of which there are eight in all and for the second and third class cabins a kosher kitchen is maintained to serve Jewish travelers exclusively.

Accommodations are divided in the usual manner, the first class being located amidships; the second class towards the stern and the third class and steerage carried both forward and aft. The officers of the vessel are quartered in the steel house raised upon the bridge deck.

Luxury of Appointments

No pains are being spared to give the great ship the most luxurious of appointments. She will have a library of 4,000 volumes in a room designed for quiet; a large and elaborately fitted gymnasium; electric, Turkish baths; a Pompeian swimming bath of 820 square feet area and 9 feet deep with a capacity of 130 tons of sea water, which is built of mosaics and marble. About the swimming bath are provided 30 dressing rooms and a gallery overhead for the use of spectators. In addition there is a public veranda café on deck decorated with flowering shrubs and trailing vines; a play room for children fitted with nursery equipment of toys and furniture; a squash tennis court; special quarters for dogs and other pets; a conservatory for preserving flowers received by passengers on sailing; a card room for bridge whist and other games; a ball room and winter garden, and ample space for concerts with a stage adapted to motion picture exhibits or vaudeville.

Throughout the vessel there are in addition many little devices for luxurious service as, for example, numerous pantries from which refreshments, such as morning bouillon or afternoon tea can be served to passengers when on the decks or in the various public rooms.

Public Rooms

The public rooms of the ship are great halls in dimensions with clear spaces and lofty ceilings not usually associated with marine architecture. The lounge has a ceiling 26 feet high, its floor dimensions being 76 feet by 54 feet. The main dining room has an area of 11,466 square feet, being 117 feet long by 98 feet wide. Its ceiling for an area of 2,300 feet is 31 feet high. The restaurant for first class passengers is 110 feet long by 54 feet wide with a ceiling 23 feet high.

Throughout the center of these apartments there is an unbroken view 250 feet long. This is made possible by the peculiar construction of the vessel's smokestacks which are

brought up from the boiler rooms near the sides of the ship in two parts that unite above the saloon deck. The grand staircases are also on the sides of the ship instead of in the center as in most vessels, thus insuring a clear sweep of unimpeded space for the great public rooms.

The smoking room on the *Majestic* is located forward with a commanding outlook ahead and on both sides through plate glass windows, differing in this respect from most vessels in which the smoking room is located farther aft.

Crew

While the exact number of persons that will be required to operate the ship has not definitely been fixed, it is thought her crew of approximately 1,100 will be divided as follows:

There will be required in the engine room about 275 men including engineers, oilers, water tenders and boiler room attendants, the latter tending the oil fires and replacing the old time coal shoveling firemen. As a coal burner the ship would require an engine room force of about 460 men.

In the deck department, including navigating and other officers and sailors, will be about 140 men.

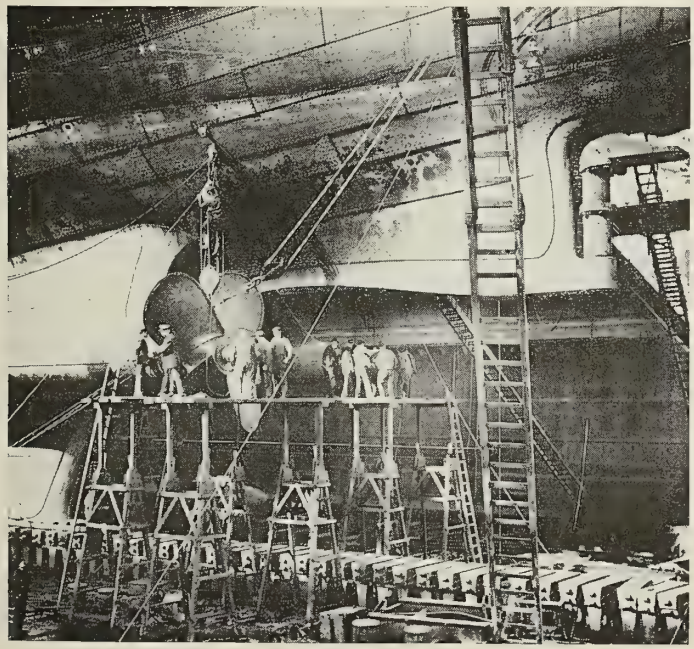
The stewards' department, including cooks, bakers, butchers, serving men, table stewards and room stewards, will be composed of about 650 men and about 25 women, the latter employed as stewardesses. Not less than 70 cooks, about 25 bakers and 15 butchers will be required in the ship's eight galleys.

Propelling Machinery

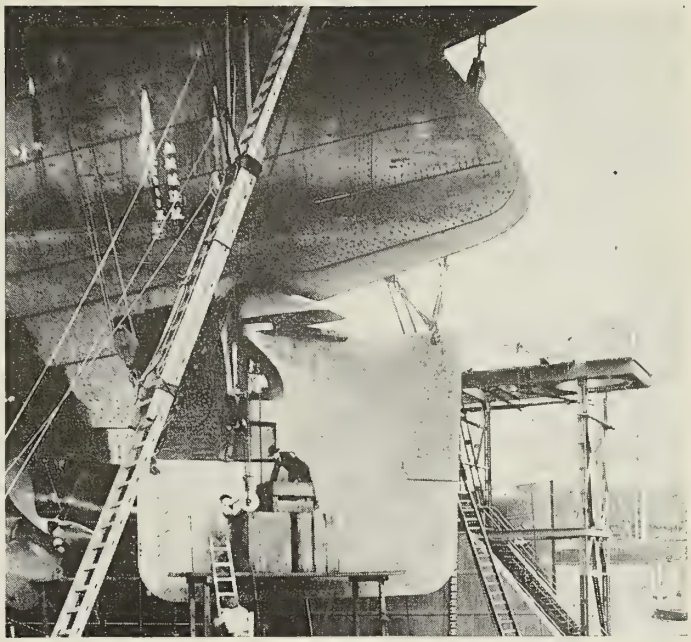
The *Majestic's* power plant, which is the largest ever fitted in a passenger vessel, will consist of eight Parsons turbines built under license by Messrs. Blohm and Voss. These turbines will drive four lines of shafting, each transmitting about 15,500 horsepower to a manganese bronze propeller of about 16 feet in diameter at 170 revolutions per minute. There will be two turbines attached to each shaft, one of which will be used for reversing.

The working combination of the turbines will be a triple expansion and they are arranged so that there is one high pressure ahead turbine on the port inboard shaft, one intermediate pressure turbine on the starboard inboard shaft and two low pressure turbines connected to the wing shafts.

The steam enters the high pressure turbine, is led from the latter to the intermediate pressure turbine and is then divided and led in equal parts to the two wing low pressure



Shipping the Port Inboard Propeller on the Majestic



The Majestic's 140-Ton Rudder Is of the Balanced Type

turbines and from there to the condensers, this arrangement of direct drive of the turbines providing for the highest degree of economy possible with this type of machinery.

With a power of about 62,000 to 64,000 horsepower the vessel will be driven at an average speed of 23 to 23½ knots. It is possible, however, to maintain without difficulty higher power and speed when burning oil. By developing 91,000 horsepower at 192 revolutions per minute at normal draft, the ship should attain nearly 26 knots under favorable weather conditions.

The eight turbines are arranged in three watertight compartments having a total length of 124 feet and on the starting platform of the main turbine room there is an indicator showing automatically by colored lights the action of the various units.

There are three specially noticeable figures with respect to the turbines, one of which is the weight of 375 tons of the low pressure turbine; the second is the greatest free length of one blade which is 2 feet and the third is the number of blades in all the turbines which amounts to 900,000.

Boilers

The boiler plant, consisting of 48 watertube boilers of the Yarrow type, represents a total heating surface of about 220,000 square feet and a grate area of about 4,000 square feet. The working pressure is 265 pounds per square inch, which is purposely high to allow for losses in the main steam pipes which are nearly 300 feet in length. As the boilers are fitted to burn oil fuel, the bunkers which were originally designed and finished for coal, have been adapted for oil.

The weight of the complete main engine and boiler plants amounts to 8,500 tons. Adding to this, however, all necessary weights for driving the ship, including hatches, funnels, bunkers and their contents, feed water, auxiliary machinery, crew and their quarters, etc., the total weight amounts to about 22,000 tons or 45 percent of the total weight of the ship.

In connection with the fuel consumption, which will be about 5,700 tons of oil on one passage, the necessary water ballast service is of interest. Upon leaving the harbor the ship will displace as a rule about 63,000 tons and the consumption of fuel, fresh water and provisions for the passage will be about 8,000 tons. This will be restored, as far as necessary for safe navigation of the ship, by putting 3,300 tons of water ballast into the double bottom compartments.

The main condensers receive their cooling water from large circulating pumps with a collective capacity of 22,000 tons per hour, the suction and pressure pipes of these pumps being 3¼ feet in diameter. There are four of these condensers which receive the steam from the low pressure turbines and which have a collective cooling surface of 66,000 square feet or about one square foot for each horsepower developed by the engines.

Another of the more important auxiliary elements in the main machinery is the forced draft for the boiler plant. There are four powerful fan arrangements drawing fresh but warm air from the turbine rooms; this is forced through two main air channels of 45 square feet area having a collective length of 1,000 feet. Besides this air service for the boilers there is another installation providing air for the crew working in the boiler rooms. The ventilation of the turbine rooms has been arranged with the same care, two large electric fans being provided whose ventilating trunks are placed in the turbine hatch ending at the foot of the third funnel 136 feet above the starting platform of the turbine room.

Heating and Refrigerating Systems

Closely connected with ventilation is cooling and heating. For the purpose of preserving the fresh provisions there is a steam-driven CO_2 refrigerating installation capable of extracting 100,000 calories an hour. A second electrically driven installation for the refrigerated forward cargo holds has a capacity for extracting 60,000 calories per hour.

The heating of the accommodations is provided by steam but all first class staterooms are also electrically heated. Each passenger can regulate this heating to suit himself.

The electrical installation consists of five turbo generators each of which develops 288 kilowatts at 115 volts at 2,000 revolutions per minute. The main switchboard is 22 feet long by 8 feet high and the collective section of all 32 feed cables leaving the switchboard is 15,000 square millimeters, whose collective value is 2,850 kilowatts. Twenty-two of these main cables are for power purposes, six are for the 15,000 lights on board and four for heating purposes. The power cables are connected to the following motors:

102 motors for ventilation, with a total horsepower of 955.
8 motors for turning and lifting the main turbines, representing 198 horsepower.
30 motors for auxiliary machinery in the galleys, with a total of 60 horsepower.
10 motors for the boat installation, developing 200 horsepower.
4 motors for the ozone-installation, developing 14 horsepower.
18 motors for elevators and winches, with 38 horsepower.
52 motors for various purposes, requiring about 100 horsepower.

The above represents a grand total of 224 motors with an aggregate capacity of 1,565 horsepower.

Besides the main electric generating station, there is an independent Diesel emergency installation of 80 horsepower which is located 19 feet above the bulkhead deck and which feeds 800 emergency lamps distributed about the vessel and is also connected to the boat machinery, the navigating and signalling elements and the emergency wireless installation. There are three independent dispatch installations, one of which is fed by an accumulator battery placed on an upper deck. Each of the three sender-installations has its own system of aerials, the largest of which has a length of 630 feet stretched between the masts of the vessel.

Marine Exposition a Combined Maritime Gathering

(*Continued from page 733*)

As to the exhibition, it was decided to designate Thursday, November 17, from 4 p. m. to 7 p. m.; Friday, November 18, from 10 a. m. to 7 p. m., and Saturday, November 19, from 10 a. m. to 7 p. m. as "Naval Architects' Days." For the convenience of those who attend the annual convention of the Society of Naval Architects and Marine Engineers, the Marine Equipment Association will operate a taxicab service between the Engineering Societies Building, where that society will meet, and the Central Mercantile Building, where the exhibition will be held. The Executive Committee of the Marine Equipment Association had previously decided to open the exhibition at 10 o'clock each morning, except on the first day, when the opening hour was set at two o'clock in the afternoon and to keep it open until 11 o'clock at night—the general public to be admitted only during the evenings, after seven o'clock. By this arrangement it will be possible for exhibitors to talk in comfort to customers and prospective customers between 10 a. m. and 7 p. m., while on the other hand there will be ample opportunity during the six evenings to exert every effort to educate the citizenry in the matter of the necessity for a real American merchant marine.

Navy and Shipping Board Co-operate

Following the conference at the Engineers' Club, Colonel Simmons went to Washington to confer with the Secretary of the Navy and officials of the United States Shipping Board with reference to exhibits that would get and hold the attention of the public and help to further the determination of the Marine Equipment Association working in conjunction with the National Marine League, to show the general public the necessity for an American merchant marine. As a result of the conference, both Mr. Denby and the Shipping Board agreed to exhibit and to otherwise co-operate in every possible way.

Shackleton's Antarctic Exploration Craft Quest, Anchored in the Thames

Fig. 1.—Motorship Formosa in Ballast

Twin Screw Motorship Formosa

9,800 Deadweight Ton Vessel a Representative Type of Modern Cargo Motorship

THE motorship *Formosa,* built by Burmeister and Wain of Copenhagen for the Swedish East Asiatic Company, is characteristic of modern methods as applied to motor cargo ships and represents a type of which a great number have been built for the East Asiatic Company, the United Steamship Company of Copenhagen and Fred Olsen & Company of Christiana. In addition, there are more ships of the same type on order for Scandinavian owners.

The *Formosa* has been built to Lloyd's class 100 A.1 as awning deck with freeboard, is fitted with three decks and five holds and has two masts. No funnel is provided other than a small one from the donkey boiler, to the top of which the exhaust pipes of main and auxiliary Diesel engines are carried.

Accommodations for the officers are provided in a deck house below the bridge at the sides of the engine casing and the crew is berthed aft in staterooms, two men to a room.

Machinery Installation

The propelling machinery consists of two main engines of Burmeister and Wain's standard six cylinder, four cycle, single acting, enclosed crosshead type fitted with forced lubrication.

To the fore end of each engine is coupled a three-stage air compressor for injection air and further the engines are fitted with fuel oil pumps, one for each cylinder.

Auxiliaries

All auxiliaries, other than the above and an auxiliary compressor, are independently driven by electricity, the motors for which are of the enclosed type built especially for the tropics.

It will be noted from the data sheet (page 741) that two cooling water pumps and two sets of forced lubricating oil pumps are provided. During daily working at sea it is only necessary to have one cooling water pump and one set of

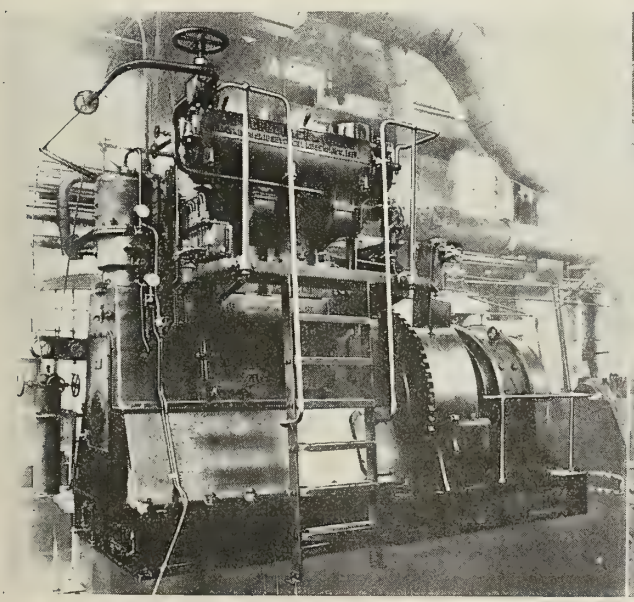


Fig. 2.—Diesel Engine Driven Generator

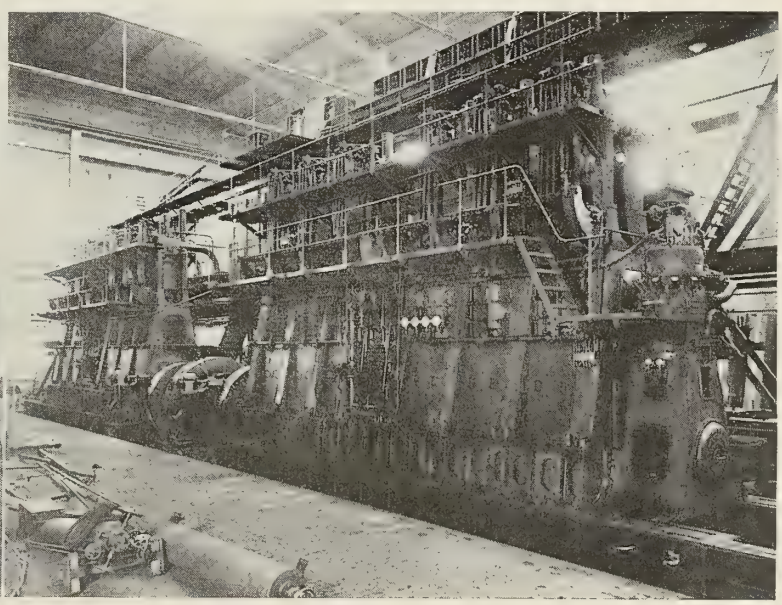


Fig. 3.—Main Engines Erected in the Shop

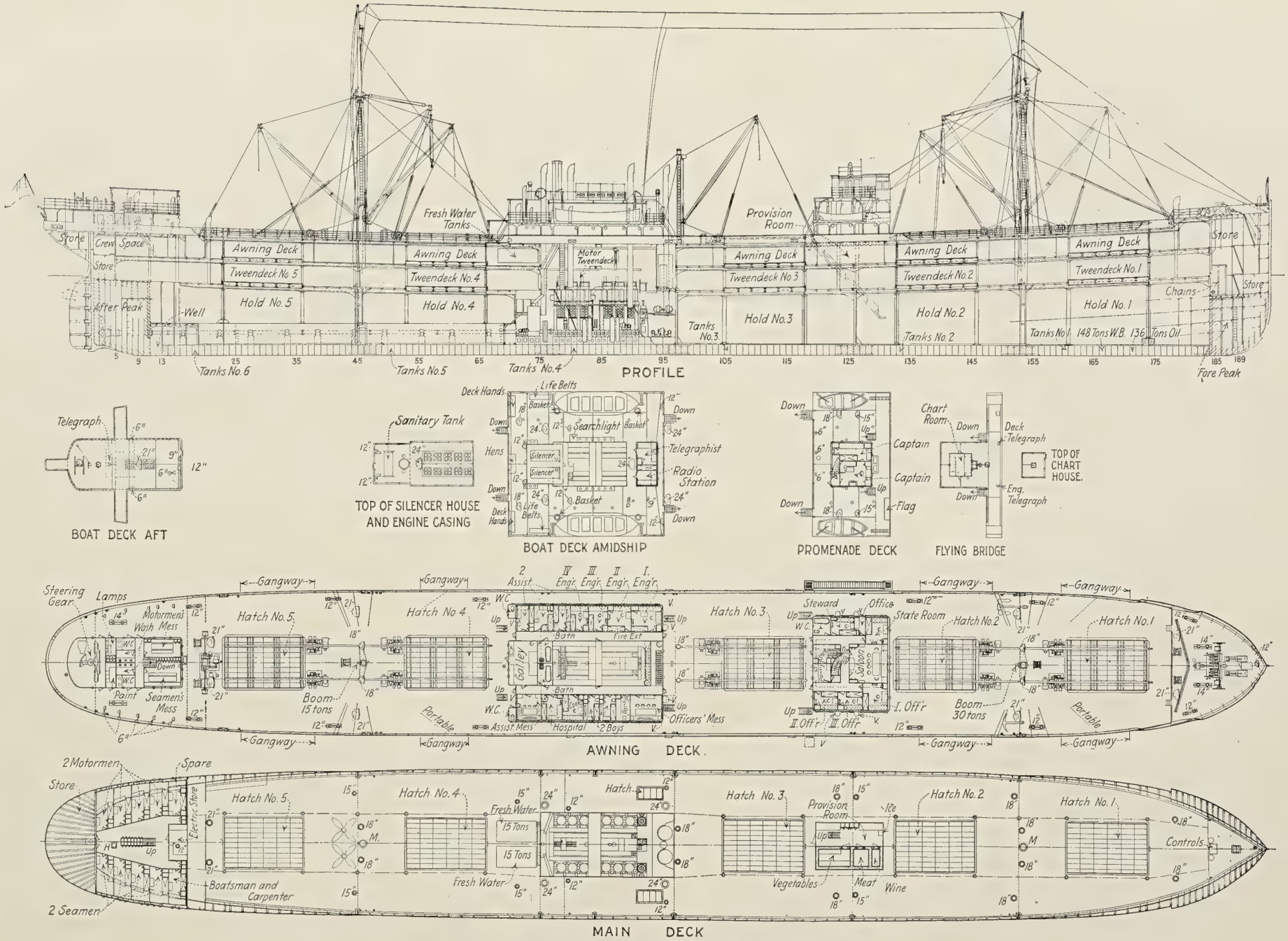


Fig. 4.—Profile and Deck Plans of Motorship Formosa

Twin Screw Motorship Formosa

General Information

Service: Freight to East Asia.
Builder: Burmeister and Wain, Copenhagen, Denmark.
Owner: The Swedish East Asiatic Company, Gothenburg, Sweden.

Characteristics

Length, overall .....442′-6″
Length, B. P.....425′-6″
Breadth, molded .....55′-0″
Depth, molded, awning deck.....38′-6″
Depth, molded, upper deck.....30′-6″
Depth, molded, lower deck.....21′-9″
Height, double bottom.....3′-8″
Draft, loaded .....29′-0½″
Draft, light .....
Block coefficient .....
Midship section coefficient .....
Longitudinal coefficient .....
Speed, loaded, knots 11.5
Cruising radius, nautical miles.....30,000
Framing .....Transverse
Class .....100 A-1 Lloyd's awning deck with freeboard

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull .....
**Weight Propelling Machinery .....
Deadweight Capacity.....9,800
Displacement 14,960

(In tons of 100 cubic feet)

Gross register .....
Net register .....

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment and Outfit.
**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez	.....	.....
Panama	.....	.....

Equipment

Anchors .....
.....
.....
.....
Chain .....
.....
.....
.....

Rudder

Area .....
Dia. Stock .....
C. Press. abaft C. L. pintles.....

Complement

Deck officers 4
Wireless operators 1
Deck crew 10
Engineer officers 10
Engineer crew 8
Purser's and steward's department..... 6
Total officers and crew 39
First-class passengers .....
Second-class passengers .....
Third-class passengers .....
Total passengers .....
Total complement 39

Handling Equipment

	No.	Type	Capacity	Length
Masts	2	Pole		
Derrick posts	2	Ventilating		
Booms	1		30-ton	
Booms	1		15-ton	
Booms	10		5-ton	

Deck Machinery

Steering Gear.....Electric hydraulic
Windlass ..... Electric
Capstans .....
Winches, electric, 5-ton.....3
Winches, electric, 3-ton.....8

Life Saving Equipment

	No.	Type	Length
Lifeboats	2		30′-0″
Dinghy	2		18′-0″
.....			
.....			

Propelling Machinery

Boilers

Number 1
Type .....Donkey
Length .....
Width or Diameter .....
Furnaces .....
Fuel ..... Oil
Draft .....
Total heating surface, square feet .....
Total grate surface or furnace volume .....
.....
Superheat, degrees F. .....
Working pressure, lbs. per sq. in .....
Normal fuel consumption:
Per day, tons, total..... 10.5
Per horsepower hour, pounds .....
Normal steam production:
Per hour per pound of fuel .....lbs
Total per hour .....lbs.

Engines

Number 2
Type, 6 cyl., 4 cyc., single acting, enclosed crosshead .....
Size,.....Bore 24.8″, stroke 37.8″
Horsepower, total indicated.....3,100

Propellers

Number 2
Type .....4 bladed, solid
Weight .....
Diameter .....
Pitch .....
R. P. M..... 125
Projected area .....
Developed area .....

Auxiliary Machinery

Machinery Space

Condensers .....
.....
.....
Evaporators .....
Distiller .....
Filters .....
Feed water heater .....
Fuel oil heaters .....
.....
Pumps:
(2) Centrifugal cooling water, directly coupled to motors.
(2) Sets, of 2 each, lubricating oil, rotary type.
(1) Fuel oil transfer, capacity 50 tons per hour.
(1) Ballast, rotating wing type, driven through gears, capacity 150 tons per hour.
(2) Bilge and sanitary triple plunger type.
(1) Maneuvering air compressor—2 stage.
(1) Emergency air compressor.
(1) Motor generator.

Refrigerating Machinery

One machine for ship's use.

Electric Equipment

Generators, three 60 k. w., 220 volts, each direct connected to a 90 B. H. P. Diesel engine.
Radio .....
Emergency .....

Holds

No.	Length	Hatches
1	.....	28′-8½″x18′-0″
2	.....	28′-8½″x18′-0″
3	.....	28′-8½″x18′-0″
4	.....	28′-8½″x18′-0″
5	.....	28′-8½″x18′-0″

Capacities

Cargo Space

Compartment	Cu. Ft. Grain	Cu. Ft. Bales
Awning deck	136,100	120,500
'Tween deck No. 1	26,500	23,800
'Tween deck No. 2	27,700	24,700
'Tween deck No. 3	29,600	26,500
'Tween deck No. 4	30,300	27,100
'Tween deck No. 5	30,100	26,100
Motor, 'tween deck	8,200	7,600
Hold No. 1	55,500	51,100
Hold No. 2	62,700	58,600
Hold No. 3	63,800	59,600
Hold No. 4	56,600	52,400
Hold No. 5	45,600	41,600
Total	572,700	519,600

Refrigerated Space

Compartment	Cu. Ft.
Ship's provisions	.....
.....	
.....	

Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons
Dble. bottom tanks No. 1			136
Dble. bottom tanks No. 2			222
Dble. bottom tanks No. 3			272
Dble. bottom tanks No. 4			154
Dble. bottom tanks No. 5			240
Dble. bottom tanks No. 6			128
Total			1,152
.....			
.....			
.....			

*....cu. ft. per ton:.....gals, per bbl.

Tanks

Compartment	Cu. Ft.	Tons F. W.	Tons S. W.
Fore peak	.....		84
Dble. bottom tanks No. 1	.....		148
Dble. bottom tanks No. 2	.....		240
Dble. bottom tanks No. 3	.....		296
Dble. bottom tanks No. 4	.....		168
Dble. bottom tanks No. 5	.....		260
Dble. bottom tanks No. 6	.....		138
After peak	.....		80
Separate F. W. tanks	.....	30	
Total	.....	30	1,414

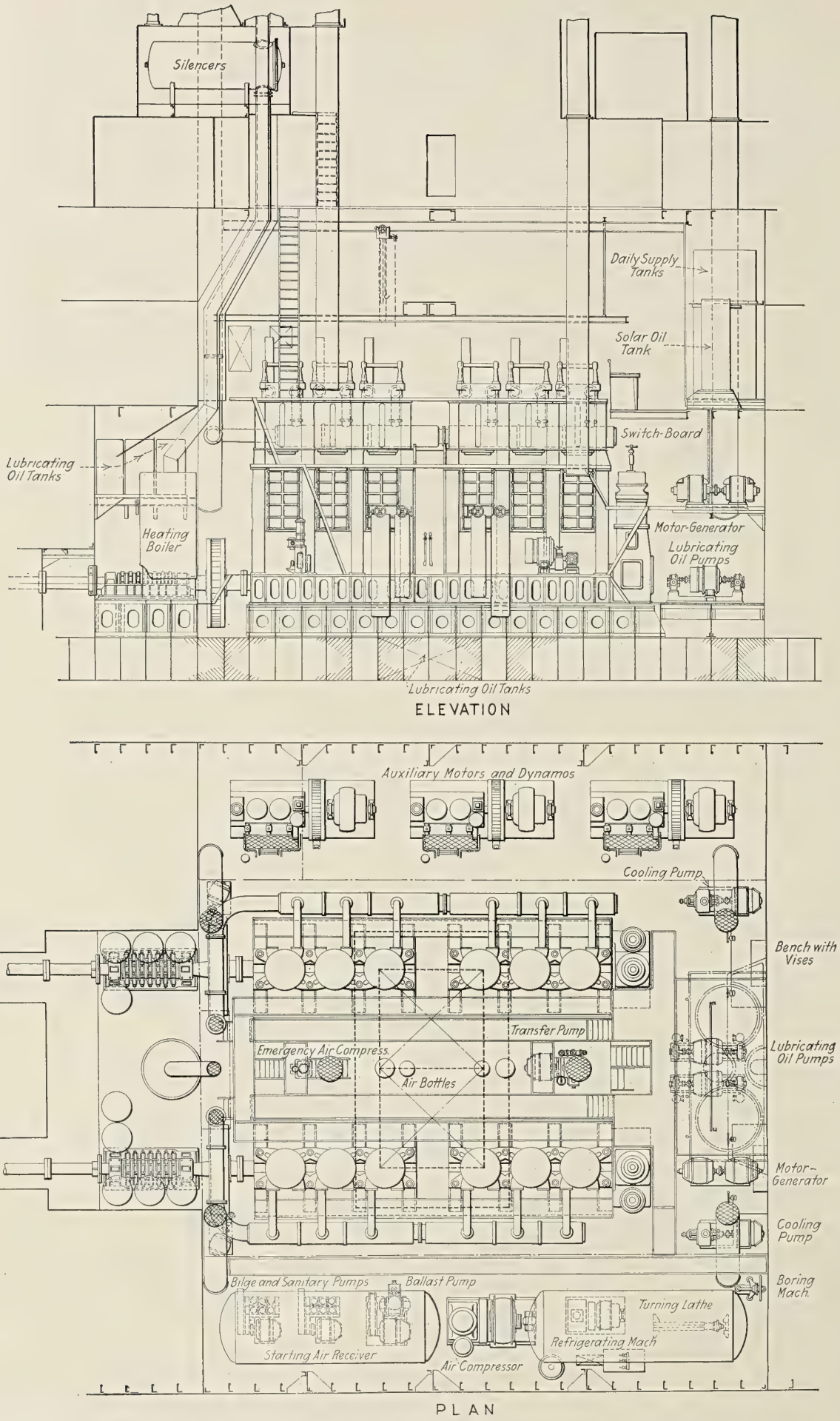


Fig. 5.—Plan and Elevation of Engine Room, Motorship Formosa

forced lubricating pumps at work, the others being provided as spares to guard against emergencies.

The fuel oil transfer pump is also connected by manifolds to permit its use for trimming the ship by transferring oil from one tank to another.

Ample provision is made for supplying the necessary air for starting and maneuvering the vessel under all conditions. In addition to the three-stage compressor directly coupled to the main engines, a two-stage, motor driven compressor for maneuvering air is installed.

For use in the event of all the air being blown from the air bottles, as may happen when the vessel is laid up for a long period, a steam driven auxiliary compressor capable of pumping up one set of air bottles for the auxiliary Diesel engines is fitted. This compressor can produce enough air in two hours to start one of the auxiliary Diesel engines and then the whole plant can be started. Steam for the auxiliary compressor is taken from the donkey boiler which is also used to provide heat throughout the vessel. Oil fuel is used for firing the donkey boiler and the burners are designed to permit the use of either steam or air for atomizing.

Two settling tanks are located on the forward engine room bulkhead and each has sufficient capacity to supply the machinery for 12 hours, thus allowing the oil to stand 12 hours for settling water and dirt before use in the engines.

Between the settling tanks a smaller tank of light oil is carried for use in starting, in this manner overcoming the starting difficulties which are common with the use of thick, heavy, crude oil, particularly in cold weather.

Electric Plant

The electric plant aboard the *Formosa* consists of three generators of 60 kilowatts at 220 volts capacity. Each generator is direct connected to a 90 brake horsepower, enclosed, trunk piston, forced lubricated Diesel engine of the Burmeister and Wain standard auxiliary type.

The generators are mounted on common bed plates with the Diesel engines and the size of the units is such that any two of them are sufficient for driving all the deck machinery in port and all the auxiliary machinery when maneuvering into or out of port. During daily working at sea it is necessary to have but one unit working and thus there is a full spare under all conditions.

The switchboard with instruments for distributing the electric current from the generators to the auxiliary machinery, deck machinery, lighting system, wireless installation, etc., is located at the forward end of the engine room below the settling tanks and a rotary transformer is fitted for reducing the current for the lighting installation from 220 to 110 volts.

Deck Machinery

Eleven electric winches, made by Allmänna Svenska Elektriska Aktiebolaget, Sweden, are provided.

The windlass is of the Clarke-Chapman type, electrically driven and the steering gear a Brown Brothers electric-hydraulic gear with a continuously running motor coupled to a hydraulic pump.

An interesting situation arose about the time the *Formosa* was preparing for her first voyage when the engineers in Sweden went on strike.

The ship sailed, however, after drawing four engineers from the technical college at Stockholm, who had never sailed before or had any training in attending such an installation, and one guaranty engineer and eight men from Burmeister and Wain's works. No difficulty was experienced due to lack of training in the engine room.

Standard Oil Tanker Empire Arrow

THE illustration below shows the oil tanker *Empire Arrow*, built for the Standard Transportation Company, New York, at the plant of the New York Shipbuilding Corporation, Camden, N. J.

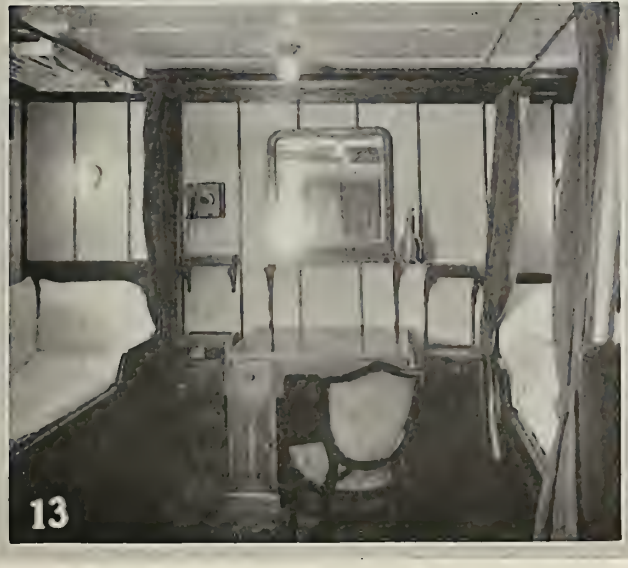
The overall dimensions of the ship are: Length, 485 feet; beam, 62 feet 6 inches; depth, 39 feet 6 inches. She is equipped with three single end Scotch boilers and one 3,200 indicated horsepower engine of the four cylinder, quadruple expansion, four crank direct acting, surface condensing type. This engine is capable of propelling the vessel, loaded to the specified draft, at a speed of 11 knots. The vessel will have ten double main cargo tanks with a combined capacity of 3,500,000 United States gallons. Her displacement is 18,277 tons and she carries a crew of 62 men.

Oil Tanker Empire Arrow on Her Trial Trip

Interior Views Showing the Passenger Accommodations O

(1) Library and Writing Room. (2) Second Class Social Hall. (3) Social Hall, Forward End. (4) Smoking Room. (5) Dining Room. (6) Social Hall, After End. (7) Second Class Lounge

le American Transatlantic Steamship George Washington

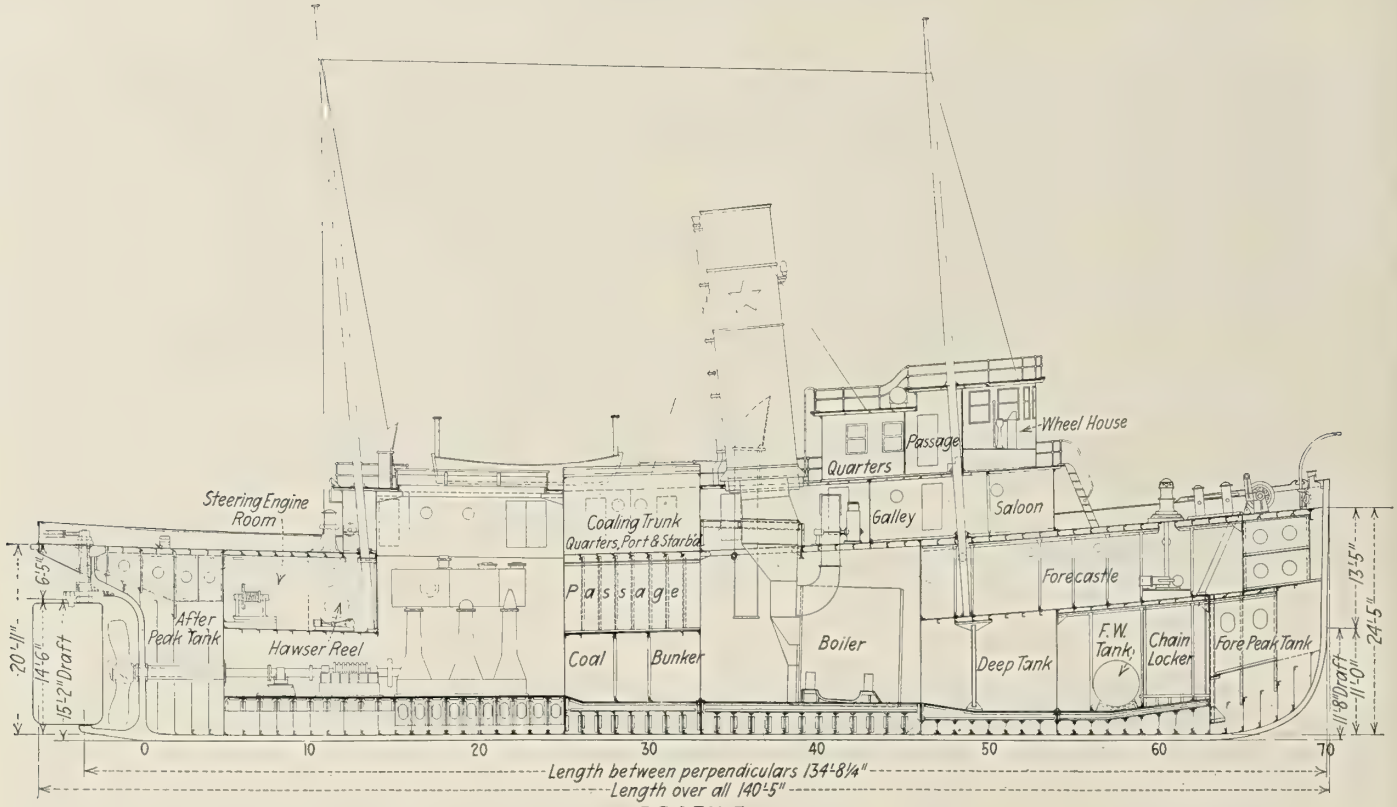


(8) Navigating Bridge. (9) Promenade Deck. (10) Suite de Luxe. (11) Stairway to Smoking Room. (12) Veranda Café. (13) Two-Berth Stateroom. (14) De Luxe Bedroom

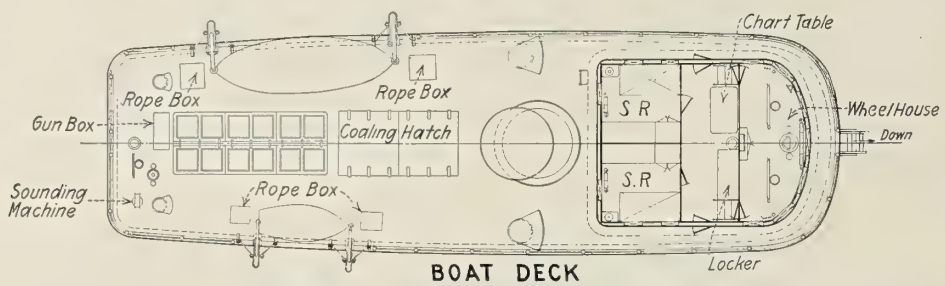
Interior Views Showing the Passenger Accommodations On The American Transatlantic Steamship George Washington

(1) Library and Writing Room. (2) Second Class Social Hall. (3) Social Hall, Forward End. (4) Smoking Room. (5) Dining Room. (6) Social Hall, After End. (7) Second Class Lounge

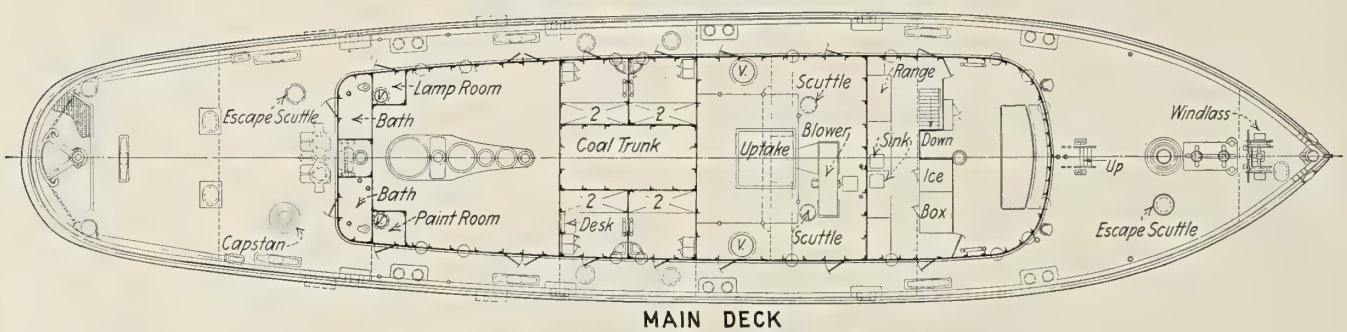
(8) Navigating Bridge. (9) Promenade Deck. (10) Suite de Luxe. (11) Stairway to Smoking Room. (12) Veranda Café. (13) Two-Berth Stateroom. (14) De Luxe Bedroom



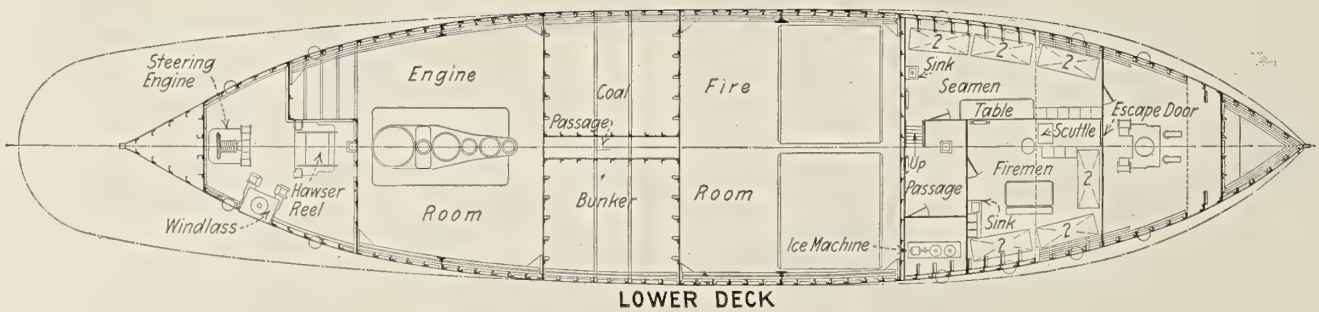
PROFILE



BOAT DECK



MAIN DECK



LOWER DECK

Profile and Deck Plans of Sea-Going Tug Adler

Tug Adler, Designed for Ocean Towing and Salvage Work

Sea-Going Tug Adler

Under normal stages of water in the Mississippi River there are currents and eddies to be contended with in the movement of vessels up and down the river and about the harbor; and when the river is high the conditions are occasionally quite severe. In addition to the difficulties sometimes attending the handling of vessels in the currents and eddies of the river, the increased size of many of the ships sailing out of New Orleans has made it necessary to provide powerful tugs to facilitate vessel movements and recent additions to the tugboat fleet are for the most part amply able to meet the requirements of their service in the harbor. But as the River and Ocean Towing Company, in considering an addition to their fleet, desired to provide for ocean towing and for salvage and wrecking operations about the passes of the lower river, the tugboat Adler, described below, was especially designed for these purposes.

THE Corona Coal Company, of Birmingham, Ala., operates at New Orleans through two subsidiaries, the River Coal Company supplying bunker coal to ocean-going vessels and the River and Ocean Towing Company handling the tugs, barges and coaling equipment used in the delivery of the coal from rail points to the ships. Conditions in the harbor of New Orleans necessitate frequent shifting of vessels in the loading and discharge of cargoes, as well as in bunkering, and much of this shifting naturally devolves upon the bunkering organizations. These companies maintain for this purpose quite a considerable fleet of tugboats, and with the constant increase of tonnage in the port the tugboat fleet is being augmented to keep pace with the requirements.

The sea-going tug *Adler*, recently placed in the service of the River and Ocean Towing Company, represents the latest practice in construction for this type of vessel. Exceptionally complete in all details, the *Adler* is built entirely of steel and was constructed under special survey to the rules of the American Bureau of Shipping, receiving class ✠ A. 1 tug service ✠ AMS.

Dimensions and Hull Data

The principal dimensions and hull data of the *Adler* are as follows:

Length overall	140 feet 3 inches
Beam molded	30 feet 0 inches
Depth (least)	18 feet 9 inches
Draft forward	11 feet 8 inches
Draft aft	15 feet 2 inches
Freeboard forward (to main deck)	13 feet 5 inches
Displacement (to above draft)	792 tons
Tons per inch of immersion	7.2 tons
Block coefficient	0.56
Midship area coefficient	0.86
Prismatic coefficient	0.65
Load waterline area coefficient	0.78

Hull

The hull is constructed of medium open hearth steel tested to classification requirements.

It is divided by transverse watertight bulkheads into seven compartments, namely, fore peak, forward hold, deep tank, boiler room, coal bunker, engine room and after peak. The peak tanks are arranged to carry fresh water for boiler feed, while the deep tank is arranged for water ballast or fuel oil in case liquid is burned.

The after body is fined away considerably, the run starting practically amidships, this shape assuring a proper flow of water to the wheel and producing a small stern wave.

Forward of the boiler room and aft of the engine room a second deck is fitted and a stringer is carried on the second deck line through the machinery space and coal bunker.

A pipe and access tunnel is arranged below the upper deck through the coal bunker, and this tunnel is the only means of communication between the boiler room and the engine room except by going on the weather deck. Sliding water-

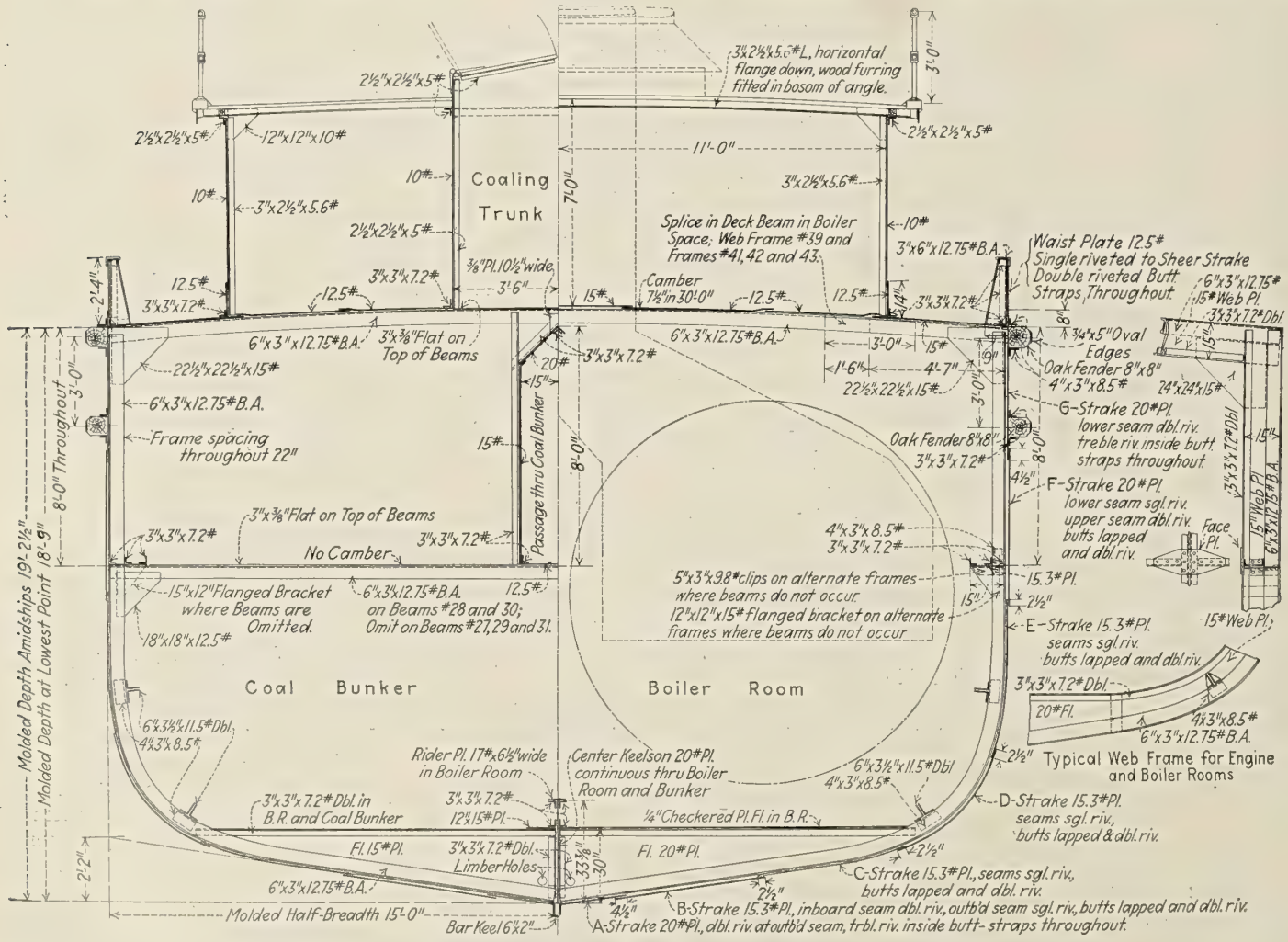
Tug Adler Ready for Launching

Taking Her Initial Dip

tight steel doors operated from the upper grating are provided in the bulkhead between the coal bunker and boiler room.

The shell and deck plate seams are single riveted except the lap of the garboard and "B" strake, the lap of the sheer and "F" strake and the laps in way of the deep tank, these being double riveted. The midship thickness of plating has been maintained throughout the vessel's length, no reduction in thickness being made at the ends.

Frames, spaced on 22 inch centers throughout, are 6-inch by 3-inch by 12.75-pound bulb angles in one piece from keel to upper deck, except in way of the deep tank where they are cut and bracketed to the tank top. From the stem aft to the deep tank intermediate ice frames of 5-inch by 3-inch by 9.8-pound angles are fitted, extending from 2 feet above the deep load line to 2 feet below the light line. The hull is further strengthened by the addition of a web frame in the boiler room and a similar arrangement in the


Coaling Trunk
Coal Bunker
Boiler Room
Passage thru Coal Bunker
Splice in Deck Beam in Boiler Space; Web Frame #39 and Frames #41, 42 and 43.
Camber 7½" in 30'0"
Waist Plate 12.5# Single riveted to Sheer Strake Double riveted Butt Straps Throughout
Oak Fender 8"x8"
G-Strake 20#Pl. lower seam dbl.riv. treble riv. inside butt straps throughout
F-Strake 20#Pl. lower seam sgl.riv. upper seam dbl.riv. butts lapped and dbl.riv.
E-Strake 15.3#Pl. seams sgl.riv. butts lapped and dbl.riv.
D-Strake 15.3#Pl. seams sgl.riv., butts lapped & dbl.riv.
C-Strake 15.3#Pl., seams sgl.riv., butts lapped and dbl.riv.
B-Strake 15.3#Pl., inboard seam dbl.riv., outb'd seam sgl.riv., butts lapped and dbl.riv.
A-Strake 20#Pl., dbl.riv. at outb'd seam, trbl.riv. inside butt-straps throughout.
Frame spacing throughout 22"
No Camber
Rider Pl. 17#x6½" wide in Boiler Room
Center Keelson 20#Pl. continuous thru Boiler Room and Bunker
Typical Web Frame for Engine and Boiler Rooms
Molded Depth Amidships 19'-2½"
Molded Depth at Lowest Point 18'-9"
8'-0" Throughout
Molded Half-Breadth 15'-0"
Bar Keel 6"x2"

Midship Section of Sea-Going Tug Adler

engine room. In the coal bunker, beams are fitted on alternate frames, in line with the second deck stringer, to tie the shell together.

Accommodation

Accommodation for 12 men is provided in the 'tween decks forward of the boiler room. This space is divided into two compartments, each being fitted with steel berths, steel clothes lockers, table, benches and wash sink with running water. Ventilation is provided by air ports and two 10-inch cowls. Deck lights, set in the upper deck, aid in lighting these spaces.

Four rooms, located amidships in the deck house, provide quarters for eight men. Each room is fitted out with two berths, steel clothes lockers and wash basins with running water. These four rooms, as well as the crew's quarters forward, are finished in yellow pine painted white. The floors in all quarters are of wood, those in the four deck house rooms being calked and paved.

A galley and saloon occupy the space in the deck house forward of the boiler casing. The galley is equipped with a six-hole Shipmate range, dresser with two sinks and a refrigerator having two compartments, one for meat and the other for vegetables. A one-ton electrically driven refrigerating machine, located on the second deck, cools the ice box. The saloon joiner work is yellow pine finished natural.

The pilot house is of steel with the interior finished in oak. The captain's and spare room each have a double built-in berth with drawers under, wardrobe, wash basin with running water and upholstered seat.

Screens are fitted to all doors and ports to the accommodations.

Deck Castings

The deck castings are extra heavy, of cast steel. Forward is a 12-inch double bitt and a 16-inch double bitt is located aft. Along the rail are located six 12-inch double side bitts, six 5-foot cleats and six fairleads securely fastened to the deck. At the stem a combination niggerhead, mooring ports and anchor davit step casting is located. This casting is of steel, in one piece, making a neat serviceable fitting.

Rudder

The rudder is of the balanced type, having an area of 99 square feet, a ratio of rudder area to lateral area of hull of 0.05. The rudder frame is of cast steel, the stock at the upper bearing being 10½ inches diameter, at the lower bearing 9¾ inches, while the stock between the bearings is 8½ inches by 14 inches. The rudder is plated on both sides of its frame with 5/16-inch plating with a wood filler between.

Propelling Machinery

The vessel is driven by a three cylinder, vertical, inverted, direct acting Stephenson link, triple expansion, Hamilton engine having cylinders 18 inches by 30 inches by 48 inches with a common stroke of 33 inches. It was designed to develop 1,400 indicated horsepower at 120 revolutions per minute using steam at 180 pounds per square inch pressure, but during the trial trip the maximum indicated horsepower developed was 1,594, this being obtained at 122 revolutions per minute and with 180 pounds of steam. The engine was later linked in to obtain a more perfect balance and to limit the indicated horsepower to 1,400 with full throttle.

Boilers

Steam is furnished at 180 pounds per square inch by two Scotch boilers, 12 feet 8 inches in diameter by 11 feet 4 inches long. The total heating surface is 3,800 square feet and the total grate surface 116 square feet. Each boiler has three 38-inch Morison furnaces fitted with shaker grates and convertible fronts for either coal or oil burning. Heated forced draft is supplied by a 66-inch fan located on a fan flat above the boilers and Diamond soot blowers are installed.

Although the vessel went into commission as a coal burner, it is a matter of but a few hours to convert her into an oil burner, the necessary equipment for making the change being carried aboard.

Auxiliary Machinery

The following auxiliary machinery was fitted:

Worthington surface condenser, 2,200 square feet.
Worthington centrifugal circulating pump, 8-inch discharge, driven by a 7½-inch by 7½-inch direct connected engine.
Worthington verticle simplex, beam, air pump, 10 inches by 18 inches by 24 inches.
Worthington vertical simplex, piston pattern, boiler feed pumps, 10 inches by 6 inches by 12 inches.
Worthington horizontal duplex sanitary and evaporator feed pump, 4½ inches by 2¾ inches by 4 inches.
Worthington horizontal duplex bilge pump, 6 inches by 4 inches by 6 inches.
Worthington horizontal duplex fire and wrecking pump, 14 inches by 10¼ inches by 12 inches.
Reilly steel shell, 20-ton evaporator.
Engberg 7½ kilowatt, 110 volt, direct current generator direct connected to a 6-inch by 5-inch engine.
Reilly feed water heater, capacity 26,000 pounds per hour, from 100 degrees to 212 degrees Fahrenheit.
Reid forced draft blower and furnace fronts, fan 66 inches, driven by a 6¼-inch by 4½-inch engine.
Coen oil burning equipment: two 4½-inch by 2¾-inch by 4-inch horizontal duplex pumps, 3 heaters and strainers.
Williamson steering engine, 6 inches by 6 inches.
Forward capstan, 7-inch by 8-inch engine.
After capstan, 6-inch by 8-inch engine.

Boiler Data and Machinery Weights

Detail boiler data and machinery weights relative to the installation are as follows:

Heating surface	2.7 square feet per indicated horsepower.
Grate area	.12 indicated horsepower per square foot of grate area.
Volume of boilers	2.1 cubic feet per indicated horsepower.
Boiler weight (without water)	104.6 pounds per indicated horsepower of engine.
Boiler weight (without water)	38.5 pounds per square foot of heating surface.
Boiler weight (without water)	1,262 pounds per square foot of grate area.
Engine weight	.70 pounds per indicated horsepower.
Condenser cooling surface	1.57 square feet per indicated horsepower.

	Weight, Pounds	Percent of Total
Weight of engine	98,000	31.9
Weight of boiler (without water)	146,436	47.7
Weight of condenser	14,750	4.8
Weight of circulating pump	5,500	1.8
Weight of air pump	3,800	1.2
Weight of boiler feed pumps	2,800	0.9
Weight of evaporator feed pump	325	0.1
Weight of bilge pump	640	0.2
Weight of fire and wrecking pump	4,800	1.6
Weight of evaporator	1,500	0.5
Weight of generator set	1,900	0.6
Weight of feed water heater	1,550	0.5
Weight of blower and furnace fronts	13,600	4.5
Weight of oil burning equipment	3,300	1.1
Weight of steering engine	8,000	2.6
		100.0

Total weight of main and auxiliary machinery without water in boiler	306,901 pounds
Weight of water in boiler, etc	84,000 pounds
Total weight, steam up	390,901 pounds
Weight per indicated horsepower (without water)	219 pounds
Weight per indicated horsepower, steam up	279 pounds

Note: The above does not include propeller, tail shaft and piping.

The stern tube is of cast iron having a split cast iron bushing 3 feet 3 inches long in the after end. In way of this bushing the tail shaft has a series of steel rings 6 inches long shrunk on. The tube is kept full of grease by means of a large compression cup located in the steering engine room. In way of the stuffing box gland the usual bronze sleeve is fitted on the tail shaft.

A four bladed cast iron propeller 11 feet 6 inches diameter and 12 feet 6 inches pitch with a blade area of 53 square feet is fitted.

A feature of interest is the arrangement of wheels in the pilot house. On account of the wheel house being about 18 feet wide it was thought desirable to install two complete steering wheels, one on either side of the centerline. The wheels are sufficiently close to the sides of the house to allow the helmsman to lean out of the sliding window provided and still be close to the wheel. Three stands with bell and whistle pulls are provided.

The *Adler* was built by the Pensacola Shipbuilding Company, Pensacola, Fla., to the order of Morris Adler and Company, Birmingham, Ala., Morris Adler and Company being the holding company for the Corona Coal Company, of which the River and Ocean Towing Company is a subsidiary. The lines for the vessel were developed by Captain J. G. Walton of the United States Coast Guard Service, Washington, D. C., who acted as naval architect for the owners. Mr. James Brown, marine superintendent of the River and Ocean Towing Company, represented the owners at the Pensacola Shipbuilding Company's yard during the construction of the vessel.

Diesel-Electric Ferryboat, Poughkeepsie

Ice-Breaking Passenger and Vehicle Ferry for Service on the Hudson River to Have Novel Type of Hull

By C. V. S. Wyckoff*

THE ferryboat *Poughkeepsie,* now being built by the Atlantic, Gulf and Pacific Company, Mill Basin, Brooklyn, N. Y., for the Poughkeepsie and Highland Ferry Company, Poughkeepsie, N. Y., will be unique in several particulars. She will be the first commercial vessel of this type to be propelled by the Diesel-electric system and the first to be built with a "hull-fin" and on the "arconstruct" principle. Because of these features, she will have an unusually large carrying capacity and is expected to be very economical in operation.

Conditions of Service

The *Poughkeepsie* will have a length over guards of 140 feet; a beam over guards of 52 feet; a beam of hull at the waterline of 46 feet; a draft of 9 feet; a displacement of 400 tons and a speed of 12 knots. Her hull will be of steel and her superstructure of wood.

She will ply between Poughkeepsie and Highland on the Hudson River, a distance of about three-quarters of a mile. The two special conditions of her service are a heavy automobile traffic in summer and thick ice in winter.

The use of the Diesel-electric drive gives her exceptional carrying-capacity because it permits of a perfectly clear main deck without a center casing or even a stack. Consequently she will have, in addition to two passenger cabins on this deck, four driveways instead of only the two permitted on steam-propelled ferries.

What this means can be understood by comparing the *Poughkeepsie* with the new Staten Island ferry, the largest of her type in America. Though this latter boat is to be 250 feet long and will have a 66-foot beam, she will have only 440 feet of driveway and a capacity of 28 cars; whereas the *Poughkeepsie* will have 472 feet of driveway and will be able to accommodate 32 cars.

In order to operate all winter, the *Poughkeepsie* will have to contend with ice up to 3 feet thick, with occasional windrows down to the bottom of the river. She will, therefore, be very substantially built; but more especially, her hull-fin design will permit her to overcome ice conditions that would tie up a boat of the ordinary type.

As shown by the drawings, the hull of the *Poughkeepsie* is of novel design. Instead of the regular narrow hull extending to the keel, she will have a comparatively shoal hull with a "hull-fin" below. This hull-fin, which is patented by Captain Samuel Golden, Brooklyn, N. Y., has several special advantages.

The hull-fin places the propellers under the boat, where they are always immersed in solid water, instead of at the extreme ends, where the water is broken and where they can emerge in rough weather. This location, together with the shape and fine ends of the fin, greatly increases the efficiency of both propellers and also permits of the use of propeller speeds that are much higher than ordinary practice, thus increasing the efficiency of the propelling machinery.

The broad hull with the fin keel imparts a high degree of stability to the vessel owing to the breadth of the stability angles. The *Poughkeepsie* could, in fact, carry her entire load on one side without capsizing. She will also possess superior maneuvering power.

The ice-breaking features of the hull-fin design are obvious at a glance. Instead of wedging into the ice, the *Poughkeepsie* will ride over it, crush it with her weight and then push it aside, exactly as the specially-designed Russian and Swedish ice-breakers act. Then, too, her rudders and propellers are so placed as to avoid actual contact with solid ice; the propellers will act as centrifugal pumps to draw the ice fragments out from under the hull.

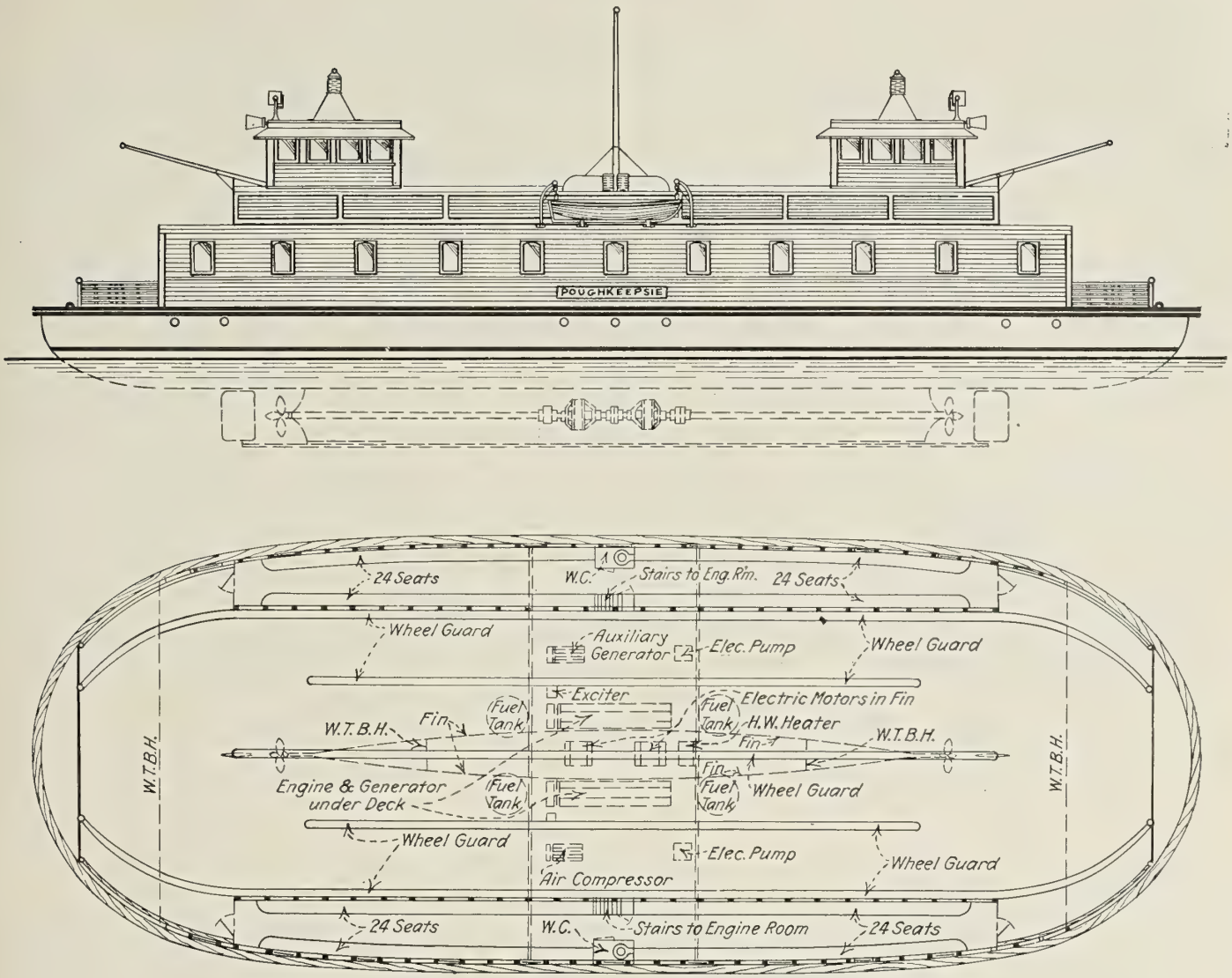
The depth of the *Poughkeepsie's* hull will be 10 feet, its draft 3½ feet and that of the hull-fin 5½ feet.

While the hull-fin admittedly adds to the cost of a given hull, its superior efficiency reduces the operating cost. In addition, this extra cost is compensated for in the *Poughkeepsie* by the use of the arconstruct system patented by Frank Nichols, of New York.

In the arconstruct system of design and construction all the relative transverse sections are arcs of the same radii. In other words, every transverse curve in the hull, whether in the bottom, bilge or side, is a relatively longer or shorter arc of the same circle.

This simplification of the lines greatly reduces the cost of the mold loft, fabrication and plating work and also increases the strength of the hull. Moreover, since the same arc is always presented to the water, the water when once

*Naval architect, sole licensee of combined "arconstruct" and "hull-fin" designs, New York and San Diego.



Profile and Deck Plan of Ferryboat Poughkeepsie

disturbed follows the hull freely without further disturbance, the usual resistance of increasing area, and thus the ship efficiency is still further increased.

Diesel-Electric Propulsion

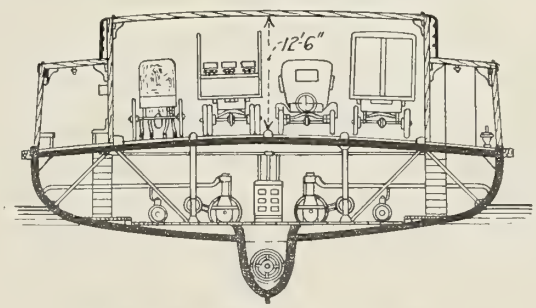
The use of the Diesel-electric system of propulsion is in accord with the best marine engineering practice for this class of vessel. The high economy and unparalleled maneuvering power of this drive are too well known to require discussion here.

There will be propeller controls in the pilot houses and in the engine room and the pilot can directly and instantly control every movement of the boat. The fact that the *Poughkeepsie* will be able to accelerate to full speed in minimum time, come to a full stop from full speed in a few seconds and reverse her motion in less time than is possible with steam drive will not only improve her schedules but will decrease the possibilities of collision or damage when entering the slip. She is, in fact, expected to make regularly three trips per hour, instead of the two trips made by the present ferryboat.

For her main engines two 150-horsepower six-cylinder Winton Diesel engines of 450 revolutions per minute, each driving a 90 kilowatt Westinghouse generator, have been specified.

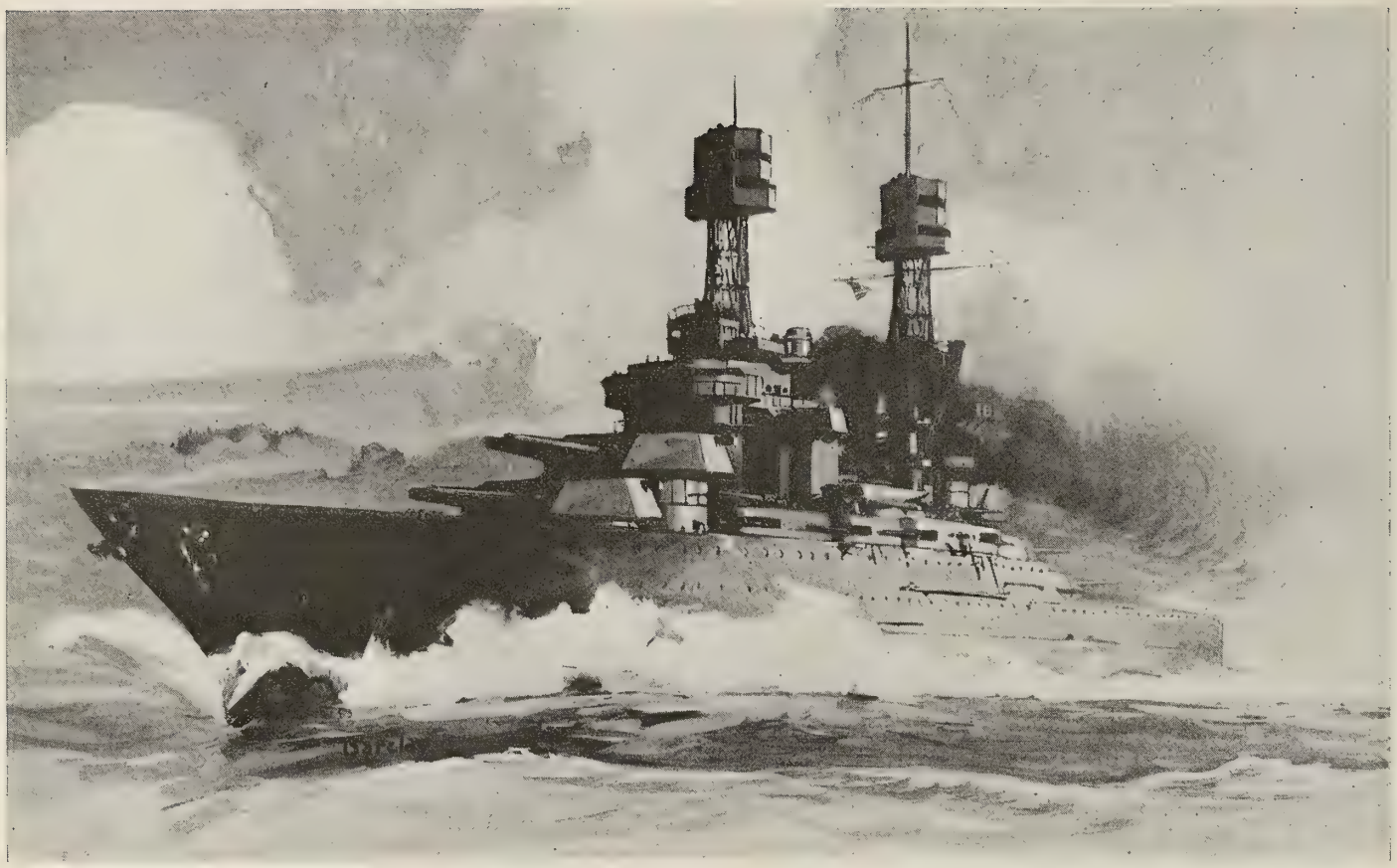
Her propellers, which are to be normally rigidly connected together, will be driven, according to specifications, by two 100-horsepower motors. Either or both engines, and either or both propeller motors, can be used at any time. The engine room will be located in the *Poughkeepsie's* hull and the propeller motors and shafting in the hull-fin.

The propellers will operate with full power at the unusually high speed of 600 revolutions per minute, but their location at the ends of the hull-fin makes this possible without cavitation or excessive slip. The propellers will be of the standard 3-blade design, 48 inches in diameter and 28 inches pitch.



Section Through Machinery Space

It is expected that the *Poughkeepsie* will be in operation by next spring.



Artist's Sketch of the Battleship Washington as She Will Look When Completed

Battleship Washington Launched at Camden

32,000-Ton Superdreadnought Christened by Ten-Year-Old Daughter of Congressman Summers—Details of the Vessel

WITH a launching weight of 16,800 tons the United States battleship *Washington* was sent down the ways at the yards of the New York Shipbuilding Corporation, Camden, N. J., for her initial dip on September 1. As the vessel started down the ways Miss Jean Summers, the ten-year-old daughter of Representative and Mrs. J. W. Summers of Walla Walla, Wash., broke a bottle of champagne against the bow and officially named the vessel the *Washington*.

The new battleship is a sister ship of the *Colorado* which was launched from an adjacent way at the same yard last March. Although authorized in 1916 and contracted for in January, 1917, construction of these two superdreadnoughts of the most powerful type afloat was not begun until the spring of 1919 as the Navy Department purposely deferred its capital ship program during the war so that all available shipbuilding capacity could be concentrated on the construction of troop and supply ships and torpedo boat destroyers to meet the immediate emergency.

The main dimensions of the vessel are as follows:

Length overall	624 feet 6 inches
Length, on waterline	600 feet 0 inches
Breadth, extreme	97 feet 5¾ inches
Depth, to main deck	47 feet 2 inches
Draft, normal	30 feet 6 inches
Displacement, normal load	about 32,600 tons
Displacement, full load	about 33,600 tons

Like all recent United States capital ships, the *Washington* will be electrically propelled. Her main engines will consist of two 15,000 horsepower Westinghouse turbo electric generators, which will generate electricity to operate four 8,300 horsepower Westinghouse motors, one for each propeller. The steam will be generated by eight watertube boilers fired by oil.

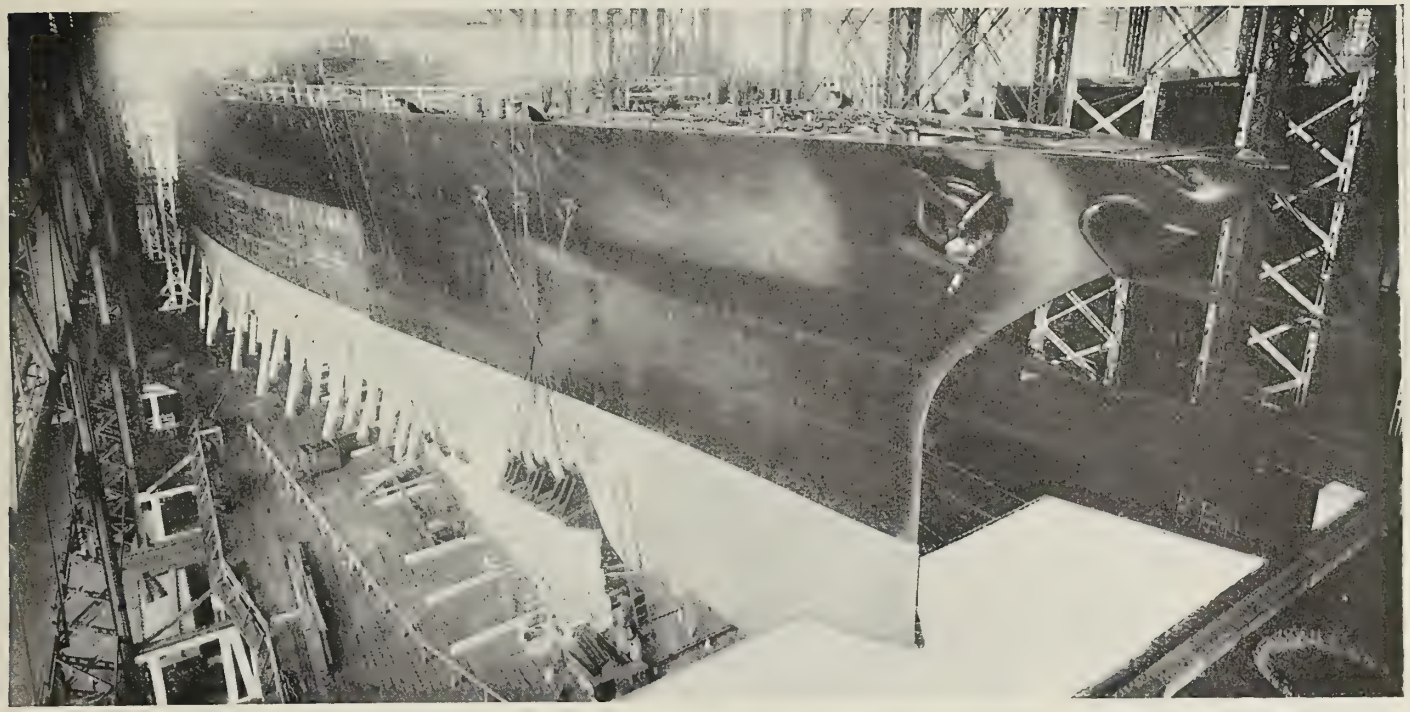
Armament

The main battery of the vessel will consist of eight 16-inch, 45 calibre breech-loading rifles, mounted in four turrets, two forward and two aft. The secondary battery will consist of fourteen 5-inch rapid fire guns placed in advantageous positions. For protection against hostile gun-fire from enemy ships all vital parts of the vessel will be adequately protected by heavy armor. This will be arranged in accordance with the best American practice.

All four turrets in which the main battery is mounted, as well as the barbettes, which contain the mechanism for turning the turrets and their guns in any desired direction, are entirely encased in heavy steel armor.

Subdivision of Hull

Probably almost as important as the armor itself, from the standpoint of protection against gun fire and torpedo attack, is the watertight subdivision of the hull. The portion of the vessel above the splinter deck, which is practically at the load waterline, is very well subdivided by watertight bulkheads, but below this deck the vessel is divided into a multitude of comparatively small watertight compartments. This is accomplished by closely spaced transverse

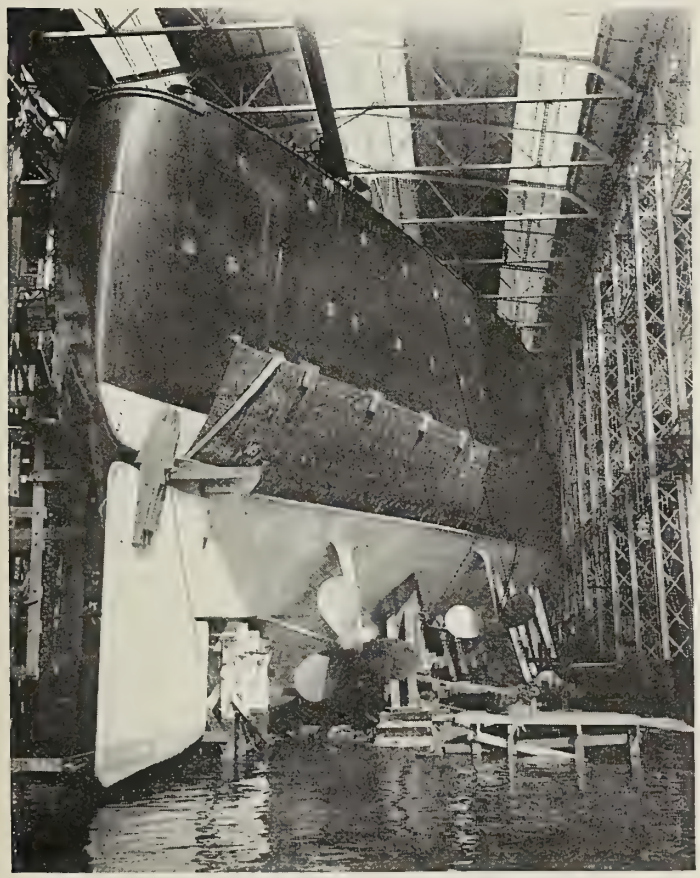


United States Battleship Washington Ready for Launching

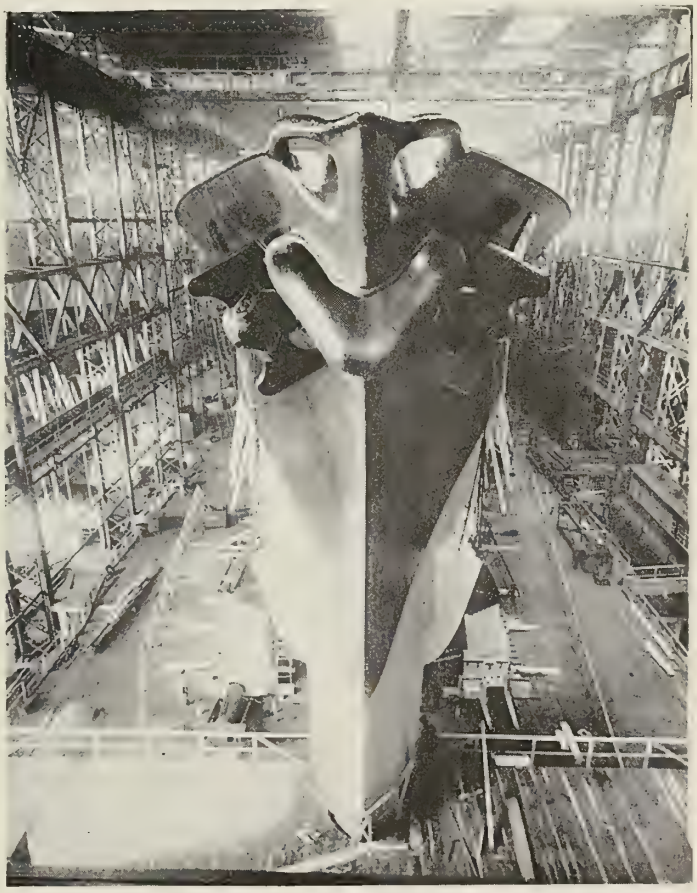
bulkheads throughout the length of the ship and several watertight longitudinal bulkheads.

Each of the eight watertube boilers is in a separate watertight compartment, as is also each of the two turbo generators which generate the electrical energy for the operation of the main propelling motors. The four main propelling motors are located in three watertight compartments. With this subdivision, even if torpedo damage should penetrate into the portion of the vessel occupied by the propelling machinery, the vessel would not be put out of commission, since the simultaneous flooding of one or more of the boiler compartments, one turbo generator compartment and one or more propelling motor compartments would neither sink the vessel nor render it unnavigable.

To operate the vessel a complement of 46 commissioned officers, 12 warrant officers and 1,022 enlisted men, includ-



Stern View Before Launching



Bow View, Taken at a Height of 75 Feet

ing 71 marines, will be carried. Accommodations for commissioned and warrant officers will be located aft on the second and third decks. The crew's quarters will be forward and amidships on the main deck and second decks.

Pronounced Flare of Bow

In general appearance the *Washington* will resemble the other capital ships recently added to our Navy. Forward her shell will have a very pronounced flare outward from the waterline to the upper deck. This flare, carried undiminished forward, naturally results in the vessel's clipper stem, intended to facilitate the stowing and handling of her anchors, of which there will be three. The pronounced flare also makes possible a roomy deck in spite of the very fine waterline forward. The upper deck is the weather deck from the stem to abaft amidships. Here the main deck, next below the upper deck, becomes the weather deck and extends as such to the stern. The stern is of the cruiser type, now common to most large war vessels.

Comparison With the Old Washington

The launching of the battleship *Washington* comes just fifteen years after the delivery by the New York Shipbuilding Corporation of the armored cruiser *Washington,* since renamed the *Seattle.* At the time of her delivery in 1906 the old *Washington* was the last word in naval construction and her size and armament, given below, form an interesting comparison with present day developments:

Length, overall	504 feet 5½ inches
Length, on load waterline	502 feet 0 inches
Breadth	72 feet10½ inches
Depth	42 feet 2¼ inches
Draft, normal	25 feet 0 inches
Displacement, normal load	14,500 tons
Fuel	Coal

The battery of this vessel consists of four 10-inch 45-calibre breech-loading rifles, sixteen 6-inch, 50-calibre, rapid-fire guns, and twenty-two 3-inch, 50-calibre, rapid-fire guns.

Between the delivery of the first *Washington* and the launching of the battleship of this name, the New York Shipbuilding Corporation has built for the United States Navy seven battleships, forty torpedo boat destroyers and a destroyer tender, and now has under construction the battleships *Colorado* and *Washington* and the battle cruiser *Saratoga.*

Close Quarter Deck Planing Machine

SWAN, Hunter and Wigham Richardson, Limited, have overcome the custom of planing by hand those portions of a ship's deck which cannot be planed by the ordinary center planing machine by using a close quarter planing machine electrically or otherwise operated. The device consists of a rotor which carries knives of special design around its circumference which is attached to the motor direct; the position of this rotor is on the extreme outside of the wagon or trolley carrying the motor and can be arranged or built for either hand. The device when applied will cut right up to within a half inch of any casing or deck houses, thus eliminating a great deal of hand work. With a device as described carrying several toothed cutters and several finishing cutters, the arrangement is such that the planing machine can be made self-propelling, the operator guiding same only.

A braking device is also employed to stop the cutter at the completion of a trip. For working between ships' frames a special device is employed, the cutter working in a vertical position or as otherwise may be required.

The cutters or knives are so arranged on the rotor that they cannot get adrift as is the practice with cutters or blades bolted down. The dovetailed principle of cutter employed in conjunction with the keeping rings removes the possibility of the knives working loose.

A spare rotor may be employed, thus always having in hand a newly ground set of blades, the whole of which can be ground without removing them from position.

The parts are shown in Fig. 1, designated as follows: (a) motor, (b) rotor, (c) section of blade, (d) keeping rings,

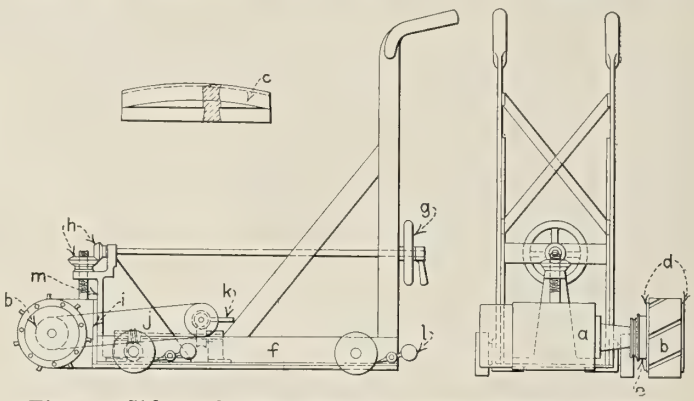
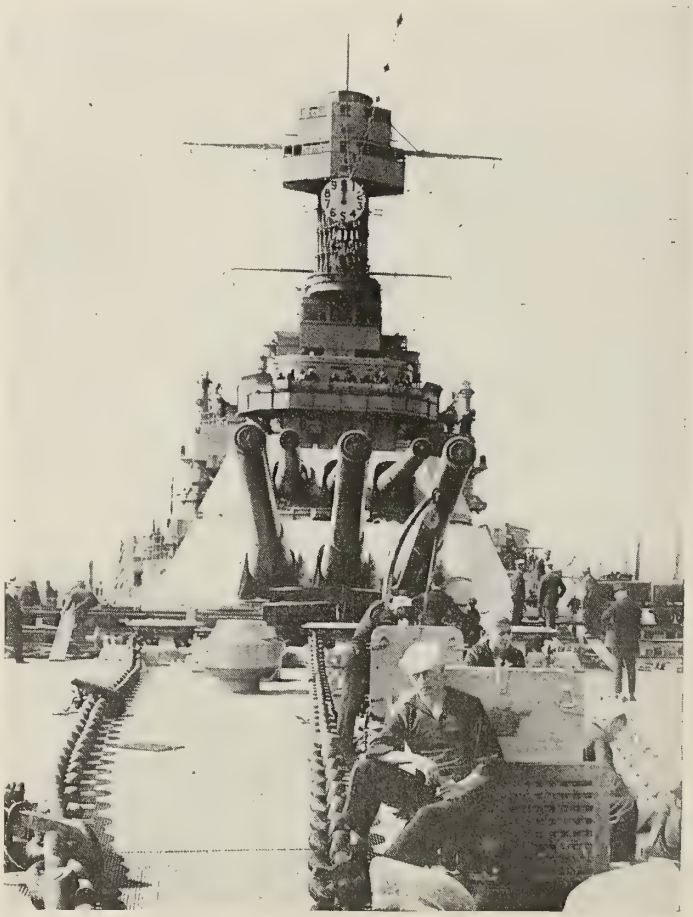


Fig. 1.—Side and End Views of Deck Planing Machine

(e) brake block, (f) wagon or trolley, (g) regulating wheel, (h) gear wheels, (i) base plate for motor (a), (k) clutch for operating gear for propelling the planes, (1) scrapers for wheels, and (m) bracket carrying gears.



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Looking Aft from the Forecastle of the United States Battleship California, Showing the Forward Turrets and Fighting Structure

Are You a Marine Engineer, Edison Standard?

Answers to the One Hundred Questions Published in August That Thomas Edison Might Ask Marine Engineers

By "Old Scotch"

THE 100 questions which I propounded, a la Edison, in the August number have, as I feared, proved a boomerang inasmuch as there has been an insistent demand from many of the readers for me to answer them myself. I think I stated that I did not guarantee that I could answer them all, on the basis that any one can ask questions which ten wise men could not answer. Without any pretense of being even *one* wise man I have made the following attempt, which until proved otherwise, can be accepted as reasonably accurate.

There are several of these answers which admittedly are controversial, and others which might be better expressed than they are. The object was to make them as simple and easily understood as possible.

1. Who built the first triple-expansion engine in this country?

The Bath Iron Works, Bath, Me. It was designed by Mr. Charles E. Hyde.

2. About what year was it installed and in what vessel?

About 1883, and it was installed in the steam yacht *Meteor,* a turtle-backed vessel originally designed to cross the Atlantic in four days.

3. Were marine boilers ever made of other material than iron or steel?

Yes.

4. If so, what material or materials were used?

Copper was used for many naval boilers.

5. Name one large American passenger vessel which used a compound oscillating engine within the past thirty-five years.

The *Connecticut* of the old Stonington Line of Sound steamers, built in 1888.

6. What is the largest American passenger vessel?

The *Leviathan.*

7. What is the largest American freight vessel?

The *Lewis Luckenbach* of 14,000 deadweight tons.

8. What is the largest horsepower used in any American-built vessel?

For American-built merchant vessels, 25,000. Naval vessels having 160,000 horsepower are now building.

9. What is the largest side-wheel steamer now in use in this country?

The Seeandbee on the Great Lakes is longer, beamier and has a greater tonnage than the *Commonwealth,* popularly supposed to be the largest side-wheeler in this country.

10-11. Has any steamer ever been built in this country which used neither screw nor paddle wheels for propulsion? If so, what method of propulsion was adopted?

Yes, a small yacht named *Evolution,* facetiously called the "squirt boat," which was propelled by two jets of water from ¾-inch nozzles, under great pressure.

12. Who invented the screw propeller?

John Ericsson is reputed to be the inventor, but many authorities give the credit to Mr. Stevens of Hoboken, N. J.

13. What vessel was known while under construction as the "dynamite gunboat"?

The *Vesuvius.*

14. What is the largest tugboat in the United States?

The *Conestoga,* 170 feet long overall and 1,200 tons displacement.

15. What is a hydrokineter and for what purpose is it used?

A hydrokineter is, as its name implies, an apparatus for heating water, and it is used to heat and circulate the water in Scotch boilers.

16. Why is bituminous coal used on steamships instead of anthracite?

Because it is cheaper, more volatile and better for steaming purposes. It is also more easy to obtain in all parts of the world.

17. What is cavitation and how is it caused?

"Cavitation" is, simply expressed, a hole in the water in which the propeller revolves, caused by the centrifugal force due to excessive revolutions, which prevents the screw from operating in "solid water."

18. How is the horsepower of a reduction geared turbine determined?

By a torsion-meter.

19. How is the horsepower of a Diesel engine ascertained?

By indicators with heavy springs.

20. What is CO_2?

Carbon dioxide; a product of good combustion.

21. What is the ideal percentage of CO_2 for efficient combustion?

About 14½ percent.

22. What is "slip" and how is it determined?

"Slip" is the difference between the distance a vessel is actually propelled through the water and the distance obtained by multiplying the pitch of the screw by the number of revolutions. It is usually expressed in percentage.

23. What is forced lubrication, as applied to marine engines?

"Forced" lubrication is, as its name implies, the forcing of oil to the bearings, either by gravity or by special pumps. It insures constant oiling of important bearings and eliminates the danger of insufficient lubrication when hand methods are used.

24. Does a triple expansion engine always have three cylinders?

Not necessarily, as frequently four cylinders are used and sometimes five.

25. How many barrels of ordinary fuel oil are equivalent in steaming value to a ton of ordinary bituminous coal?

About 2.8 barrels of oil should be equivalent to 1 ton (2,240 pounds) of steaming coal.

26. What are the purposes of a deep tank on a freight vessel?

The primary purpose is to carry water ballast when the ship is light and to raise the center of gravity of the ballast carried, to insure easier rolling in a seaway. At times it is used to carry liquid cargoes or oil fuel.

27. What is the mechanical equivalent of a heat unit?

Seven hundred and seventy-eight foot-pounds of energy, known as Joule's equivalent.

28. What other material than wrought iron or wrought steel is sometimes used for anchor chains?

Cast steel is now used successfully.

29. Who produced the first successful marine steam turbine?

Sir Charles Parsons.

30. How many cubic feet are there to a ton of bituminous coal?

Forty-two, generally adopted.

31. What is the temperature of steam corresponding to a gage pressure of 200 pounds per square inch?

381.7 degrees F.

32. What is the generally adopted diameter of condenser tubes?

Five-eighths inch outside diameter is most generally used and occasionally ¾ inch.

33. What type of condenser is almost universally used on Great Lakes steamers?

The jet condenser, where the cooling water mixes with the condensate.

34. What is meant by a triple effect evaporator?

Where three evaporators are used and the generated steam of No. 1 is used to generate steam in No. 2 and the steam generated in No. 2 is used to generate steam in No. 3.

35. How would you determine whether or not distilled water contained salt?

The simplest method is to add a few drops of nitrate of silver to a glassful of the distilled water. If any chlorine is present the water will become clouded by the chemical reaction.

36. What is meant by 28 inches of vacuum?

By 28 inches of vacuum is meant that all air is excluded from the container except an amount equivalent to the difference between 30 and 28. The weight of the atmosphere at sea level is assumed to be equivalent, per square inch, to the weight of a column of mercury 30 inches high. Hence 28 inches of vacuum means all air removed except an amount, per square inch, equal in weight to a column of mercury 2 inches high. In reality a cubic inch of mercury at 60 degrees temperature weighs 0.49 pound and the atmospheric pressure is therefore 14.723 pounds per square inch. A perfect vacuum is therefore 29.44 inches.

37. What is meant by 2½ inches of air pressure in a firerоom?

The height in inches shown in a U-tube containing water, one end of which is connected to the space under pressure and the other end to the atmosphere.

38. What is a single acting engine?

An engine which receives propulsive impetus on one side of the piston only.

39. What is an average temperature at the bottom of the smokestack?

About 600 degrees F.

40. Were geared marine engines ever used before 1900?

Yes.

41. If so, wherein did they very materially differ from present types of geared turbines?

In Civil War days certain vessels were fitted with engines "geared up," whereas all modern marine geared engines are "geared down." In other words, the first type drove the propeller at a greater number of revolutions than the engine, while with present types the propeller runs at much less revolutions than the engine.

42. What was the name of the first steam vessel which crossed the Atlantic?

The *Savannah.*

43. What firm, now in existence, built the original *Monitor?*

Continental Iron Works, Greenpoint, N. Y.

44. Name an American educational institution entirely devoted to naval architecture and marine engineering.

Webb Academy at Fordham Heights, N. Y.

45. Who is the present head of the Steamboat Inspection Service and what is his official title?

George Uhler, Supervising Inspector General.

46. Name three well known manufacturers of marine pumps.

Worthington, Davidson, Bethlehem.

47. What is a pneumercator, and what is its purpose?

An instrument for indicating the height of liquids in tanks: they can be placed in any part of the ship and give accurate relative heights. They are also used to indicate the draft of the vessel.

48. How many members are there to the Shipping Board?

Seven (7).

49. What is a "red ink" license, and why are they so called?

A "red ink" license is a United States Steamboat Inspection license granted to alien officers on account of war conditions: so-called because the regulations required a notation on the license written in red ink.

50. What department of the Government has jurisdiction over the Lighthouse Service?

Department of Commerce.

51. How much toll will have to be paid by a 5,000 net tonnage freighter going through the Panama Canal, loaded?

$1.25 per net registered ton, hence the toll will be $6,250.

52. How are the living quarters on a motorship heated?

Either by steam from a donkey boiler or by electric heaters.

53. Is there any patent on a Diesel engine?

No, the original patent taken out by Dr. Diesel has long since expired.

54. What is the origin of the term "starboard"?

The right hand side of a vessel looking forward. From the Saxon word, "steoran," to steer, and "bord," a plank or board. In ancient galleys the craft was steered by a steerboard on the right hand quarter.

55. For what is a clinometer used on shipboard?

To measure the heel of a ship, or how far to either side of a vertical line the ship may be inclined to port or starboard.

56. State Simpson's rule.

Simpson's rule is used to determine the area of an irregular figure such as the plane of a waterline or an indicator card. The rule is to divide the base into any number of equal parts which will give an odd number of points of division. Measuse the lengths of these perpendiculars or ordinates, and to the sum of the lengths of the first and last ordinates add four times the sum of the lengths of all the even numbered ordinates and twice the sum of the odd. Multiply their sum by one-third of the distance between the ordinates and the product will give the area required.

57. What is a planimeter?

An instrument for measuring the area of any irregular figure, such as an indicator card, etc.

58. For what length of time is a marine engineer's license good?

Five years.

59 What is the "deadweight" tonnage of a ship?

Deadweight capacity of a ship is the weight of cargo she can carry to her summer loadline, and generally includes bunker coal, water in boilers and weight of crew. It is approximately 64 percent of the ship's displacement.

60. What materials should be used for suction pipes in bilges?

Wrought iron, preferably galvanized.

61. What is the approximate area of smokestack in proportion to the grate surface?

About one-sixth the total grate area.

62. Why should the use of cylinder oil be restricted to a minimum?

On account of its bad effect on the boilers, as it becomes mixed with the feed water in the condenser.

63. From what is the term "monkey" wrench derived?

Said to be from its inventor, an Englishman named Munckey.

64. How many cubic inches are there in a gallon of oil?

Two hundred and thirty-one.

65. Why should not alternating current be used for the lighting set?

Alternating current is more liable to grounds and liable to start fires, hence nearly all current for lighting purposes on board ship is direct current.

66. What is the average percentage of electrical loss between generator and motor in an electrically driven ship?

About five percent.

67. What are the proper proportions of glycerine and water in a hydraulic telemotor steering gear system? Why is glycerine used?

About 30 percent glycerine and 70 percent water. The principal reason for its use is to prevent freezing.

68. What is a fair steam consumption per horsepower for a turbine reduction main drive?

About eleven pounds.

69. What material is mostly used to line stern bearings?

Lignum vitæ is almost universally used.

70. Name four of the principal American manufacturers of turbine reduction marine engines.

De Laval, General Electric, Westinghouse and Kerr.

71. Who was the inventor of the most generally used bilge suction strainer?

The late Chief Engineer Macomb of the United States Navy.

72. What is the principle on which an ordinary pyrometer works?

The difference in expansion between two metals.

73. What is the correct position to place a draft gage in a forced draft system?

In front of the ashpit.

74. What should be the maximum chlorine contents of feed water for watertube boilers?

Not to exceed 50 grains per gallon.

75. The same for Scotch boilers?

As high as 100 grains can be used safely, but it should be kept much lower.

76. How should a steam deck winch be safeguarded in freezing weather?

Carefully drained of all water, to prevent damage from freezing.

77. Name three principal causes of excessive sparking of brushes on a marine generator?

Hard spots in brushes, roughness of the commutator and brushes improperly placed.

78. If three water gage glasses on a marine boiler should break within an hour, what would you think caused it?

The fittings would most likely be out of line.

79. Why is zinc used in a boiler?

To prevent excessive corrosion and pitting.

80. When should zinc plates be used around the stern post and rudder post?

When the material from which the propeller is cast is other than iron or steel.

81. Why are load lines fixed for sea-going vessels?

To prevent unsafe loading of vessels.

82. What elements should be considered in certifying to the amount of fuel oil received, if the contract is by the barrel, and payments are to be made by the ton?

Temperature and specific gravity.

83. What causes spontaneous combustion in a ship's bunkers?

Moisture, iron pyrites in the coal and improper ventilation.

84. What materials are generally used to filter feed water for marine boilers?

Loofas, sponges, old bagging and excelsior.

85. What precautions should be taken before sending a man into a tank which has contained fuel oil?

It should be thoroughly steamed out, have air blown through it and the air satisfactorily tested before a man enters.

86. What superiority has a Diesel engine over a steam engine for marine propulsion?

Greater fuel economy, less space occupied and fewer attendants.

87. Wherein does a steam siren differ from an ordinary whistle?

In an ordinary whistle the steam is blown direct into the bell, and gives forth a uniform tone. In a siren the flow of steam is varied by a rotating disk or other device to give a variation of sound, regulated by the speed of the disk.

88. What is cop waste?

Cotton thread which becomes hopelessly tangled or snarled on the spindles.

89. What treatment is best for bad steam burns?

Carron oil composed of an emulsion of lime and linseed oil, or any other substance which will exclude contact with the air and not further injure the burned flesh or skin.

90. What is meant by a "feathering" paddle wheel?

"Feathering" paddle wheels are those wherein the buckets or blades enter and leave the water normal to its surface. They are actuated by eccentrics on the shaft.

91. How are steam gages tested for accuracy?

Steam gages should be tested by comparison with standard gages. A much better method is to test by a gage testing machine, which through a U-tube compares the markings on the gage with actual weights.

92. What is the difference between a tube and a pipe?

The essential difference is that all pipes are based on gas pipe sizes, while tubes are usually of an outside diameter equal to the size by which they are designated. For example, a 1-inch pipe is actually 1.31 inches outside diameter, 1.05 inches inside diameter, and a 1-inch tube is actually 1 inch outside diameter, and the inside diameter varies in accordance with the thickness of the metal used.

93. What is a dynamometer?

A dynamometer is an apparatus used to determine the work performed by any motor or machine.

94. Will a gasoline engine work in a motorboat without a clutch?

Yes, for engines of small power.

95. For what purpose is a devil's claw used on board ship?

A "devil's claw" is used by firemen for breaking up and hauling out clinkers and otherwise for manipulating soft coal fires.

96. Who is the president of the American Society of Naval Architects and Marine Engineers?

Rear Admiral W. L. Capps, U. S. N.

97. Name three prominent marine papers published in the United States.

Marine Engineering and Shipping Age, *Marine Journal* and *Pacific Marine Review.*

98. What is the leading treatise on marine engineering published in America?

Dyson's "Practical Marine Engineering" is about the best treatise on the subject.

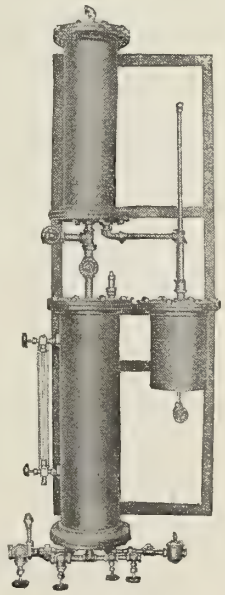
99. What is the Naperian logarithm?

A Naperian or hyperbolic logarithm is one whose base is 2.718281. The so-called common logarithm is one the base of which is 10. The Naperian log is equal to the common log $\times$ 2.302585.

100. Give ten good reasons why marine engineers have to know more than locomotive engineers. Name one hundred if you like

While a hundred good reasons could be written the following only is necessary. A real marine engineer is a man who can operate his machinery continuously for periods of 30 days, if necessary, away from all outside help, make all repairs, and must combine skill as a machinist, boiler maker, pattern maker, plumber, steam fitter, coppersmith, electrician, etc. Most locomotive engineers are merely starters and stoppers.

Evaporator Designed to Supply Small Quantities of Distilled Water



Evaporator Set

A SMALL evaporator set having a capacity of from 15 to 30 gallons of distilled water an hour depending upon the steam pressure available is being supplied by the Griscom-Russell Company, New York. The set consists of an evaporator of the "Reilly" type containing coils of brass tubing to which steam is supplied. The vapor from this evaporator passes to a distiller and is condensed in the coils of this unit by water which circulates through the shell. If the distilled water is to be used for drinking purposes it is passed through an aerating filter, but if for laboratory or manufacturing uses, the filter is omitted from the set. The complete set is mounted on an angle iron frame, as shown in the accompanying illustration, and is ready for the steam and water connections. The height of the set ready for installation is 7 feet and its width 2 feet 4 inches.

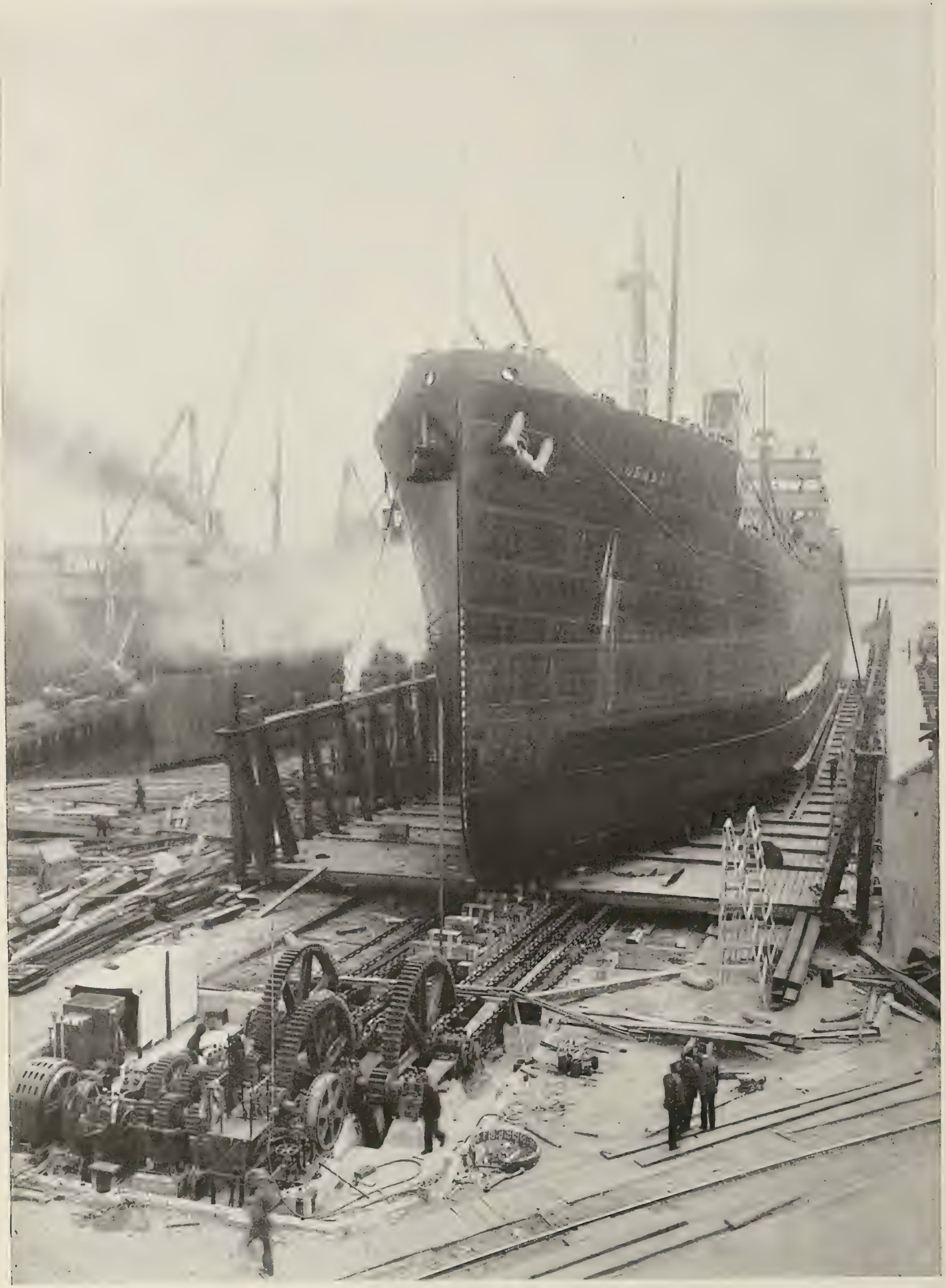


Fig. 1.—View of Railway Dry Dock No. 2 Lifting the Steamship Orani at the Moore Shipyard, Oakland, Cal., Showing the Hoisting Machinery, Chains and Roller Tracks by Means of Which the Dock Is Operated

Railway Dry Docks at the Moore Shipyard

Anticipating an extensive demand for ship repairing facilities and to supplement and partially supersede a wartime shipbuilding program, the Moore Shipbuilding Company of Oakland, Cal., has recently added to its equipment a number of dry docks designed and built under the direction of Leland S. Rosener, consulting engineer, San Francisco, Cal. Among these are two railway dry docks, each capable of handling vessels of from 15,000 to 20,000 deadweight tons, which are the largest docks of the type in the world.

IN addition to two floating dry docks, each with a capacity for lifting ships weighing 12,000 long tons or of from 25,000 to 30,000 tons deadweight capacity, so arranged that they can be combined into a single dock having a capacity for ships weighing up to 21,000 long tons (700 feet in length), the Moore Shipbuilding Company, Oakland, Cal., has added to its equipment three dry docks of the railway type. One of these, an old one, was rebuilt in 1919 to give it a capacity for ships weighing 5,200 long tons. At that time this was the largest dock of its kind in the world. In 1920 two larger docks of the same type were built side by side, one with a capacity for lifting ships weighing 7,500 long tons and the other for ships weighing 8,000 long tons. Accommodating, as they do, ships up to 500 feet in length with a deadweight capacity of from 15,000 to 20,000 tons, the new docks are capable of handling the majority of ocean-going cargo ships and tankers comprising the majority of the American merchant marine, even with a partial cargo or fuel supply on board.

General Arrangement

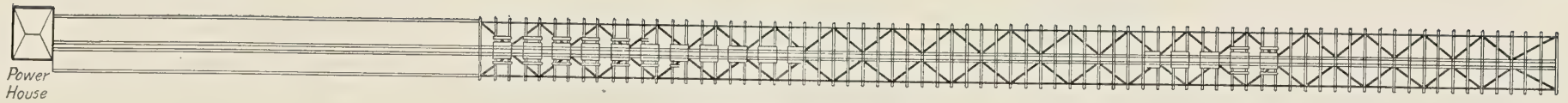
Such docks are of comparatively low initial cost and can be built quickly as compared with docks of other types. Adding to this feature the fact that they can be operated cheaply and quickly makes them especially useful to ship repairing concerns. The average time for docking a ship is about 40 minutes from the time the ship enters the dock. In one instance three ships were docked on these three railways by one crew on a single tide.

Fig. 3 shows the general arrangement of one of the marine railways. Each dock consists of a cradle approximately 500 feet long and 76 feet wide, an inclined track system upon which the cradle moves from its point of maximum submersion to a point above the high water line and a hauling system consisting of a set of chains operated by an electrically driven hoisting mechanism. Each of these new docks is hauled by eight chains arranged in parallel and automatically equalized. The chains are made of refined iron, hand-welded and thoroughly proof tested at the factory. Fig. 1 gives a good view of the chain and hoist arrangement, the photograph having been taken before the erection of the power house. The tracks and roller trains under the ends of the cradle may also be seen.

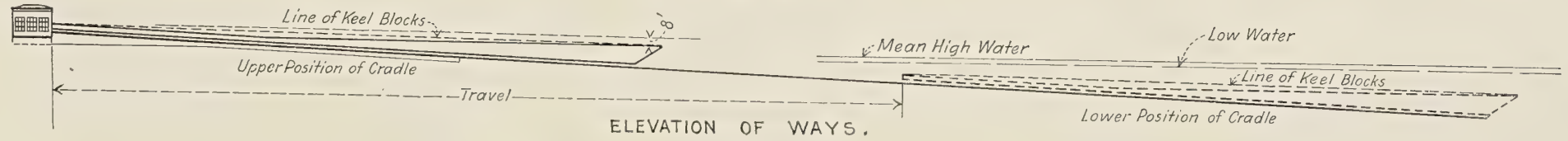
Hoisting Machinery

The hoists were built in the Moore Shipbuilding Company's shops from Mr. Rosener's design. They are driven by 500 horsepower slip ring 450 revolutions per minute motors controlled by liquid rheostats and magnetic control. The electric equipment was supplied by the General Electric Company, Schenectady, N. Y. Speed reduction from the motors to the main-head shafts, on which the chain wildcats are mounted, is made through three sets of spur gears. All of the gears are of steel, the fast train of motor reduction gears being cut and the other slower trains being cast gears. When lowering a ship regenerative braking is used, that is, the main motor being driven overspeed returns energy to the line. This practically eliminates the use of the hand operated post brakes and the air operated band brakes, these being used only at the instant of stopping or in an emergency. A

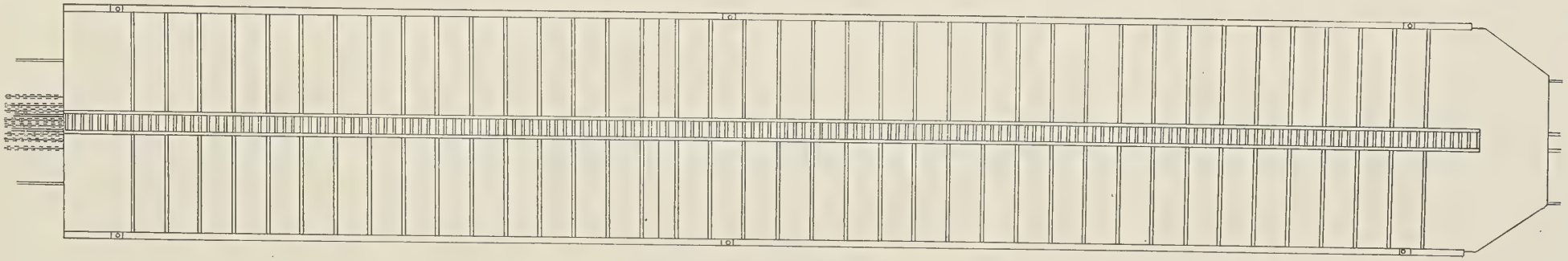
Fig. 2.—Vessels Hauled Out for Repairs on Railway Dry Docks at Moore Shipyard. Between the Docks Can Be Seen the 4-Wire Trolley System



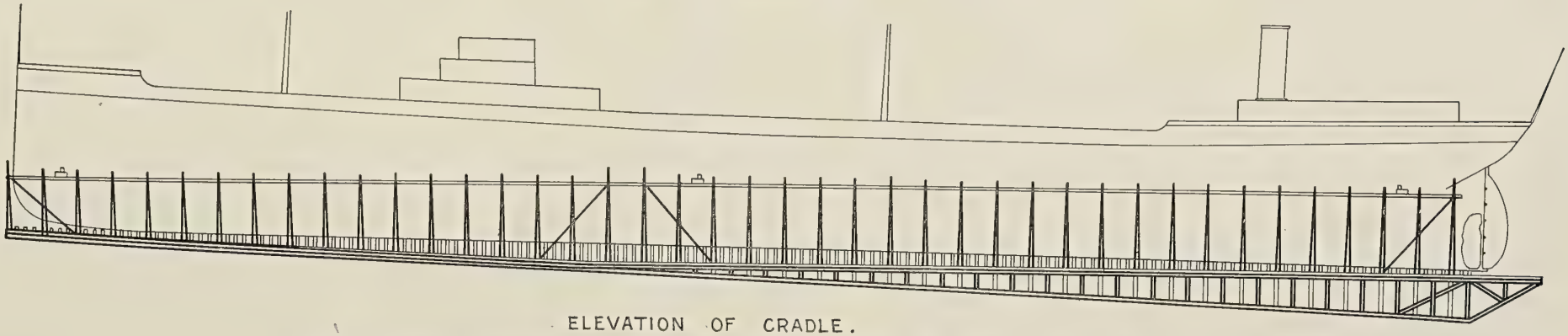
PLAN OF WAYS.



ELEVATION OF WAYS.



PLAN OF CRADLE.



ELEVATION OF CRADLE.

Fig. 3.—General Arrangement of Ways and Cradle of Railway Dry Docks at Moore Shipyard

combination clutch and gear shifting arrangement permits operating the hoists at a low speed of 16 feet per minute for large ships, or at a speed of 28 feet per minute for lighter loads.

The cradles are provided with elevated framework on the sides, which is always above water. Hand winches for controlling the bilge blocks are mounted on the elevated sides or runways as are also electric capstans (see Fig. 2) for floating the vessel to the proper location over the blocks.

Between the two ships in Fig. 2 may be seen covered trolley ways supported on piles in which are housed two 4-wire trolley systems for supplying electric current to the ships both for lighting and for operation of the electric capstans. The fourth wire is for a signal system, the other side of which is grounded. With this the dock master on the railway signals to the hoisting engineer in the power house. The trolleys consist of bare wires loosely supported on insulators. A collector device attached to the cradle serves to conduct the current to the wiring system on the cradle.

The actual power used to operate these docks varies from a minimum, when the ship is floating, to a maximum, when it is entirely out of the water. In docking the concrete ship *Palo Alto,* weighing 7,115 tons, the power varied from 165 to 565 horsepower, the larger amount being required for only about five minutes at the end of the hoisting period.

Liquid rheostats for controlling the speed of the hoist are ideal, inasmuch as they give very even and gradual acceleration, thus avoiding sudden jerks and consequent strains inherent with grid resistance where the speed is increased in a series of steps.

The Most Interesting Job in the Yard

Which do YOU *think is the most interesting job in the yard? Is it yours? Tell us about it! The letter printed below, taken from the monthly journal of Smith's Dock Company, Ltd., one of the foremost ship repair companies in England, tells why machining in the engineering department has a claim to this title. This is a challenge we invite our readers to accept. All letters published will be paid for at space rates. Speak up! Who's next?*

THERE are several who have laid claim to the title of the most interesting job in the yard, but, from my point of view, they all fail to establish their claim to the title. I claim that my section, or branch, of the work is the most interesting job in the whole category, and that is, machining in the engineering department, embracing, as it does, from drilling 1/16 inch holes to boring out cylinders.

Anyone taking up machining undergoes a course of training beginning with drilling, going right on through screwing, sawing, planing, slotting, milling, shaping, boring, turret lathe, wall-planing.

Very interesting work it is, too. The pleasure and pride of being able to set your jobs and machines so that your work is so accurate that the parts machined fit into their places without any persuasion from quarter hammer or files must be experienced to be appreciated.

We will take drilling as a starting point. The machinist in the making finds a great amount of pleasure, fun and interest in chasing the pops into their proper places and, after the marker-off has performed, this takes some doing.

Next comes sawing. Well, there is a knack of making a saw stick to the track, and once on the right track it is expected to do even time. (Foreman's opinion.)

Shaping comes next. And the interest becomes deeper when you commence to get the tools licked, or ground into the right shape, so as to get the most off in one cut with the least strain and resistance on both tools and machine.

Slotting follows shaping in interest and importance. At first sight a slotting machine gives one the impression of a shaping machine up-ended, but soon its possibilities begin to show themselves as radius work and dovetailing with tapered key-ways, etc., are taken in hand. The first thing that strikes one on a slotting machine is the tendency to put one's fingers where they have no right to be. (See safety first.)

The milling machine, to my mind, takes first place in machining, but it is the last to be introduced into many shops. Almost all jobs come in right for a milling machine. Some fine work I have seen and done on a milling machine from a ½ inch key to milling crank webs, both on the flats and around the outsides.

Planing is nearly like shaping, only one can get bigger work on the machine and handle it with more room to spare for fastening down. The Lancashire drive is a grand invention that makes planing a much more interesting job than ever before. The speeds on the old machines were dead slow and stop, but on these latest there is a great variety of speeds, which makes it possible to do any job, be it either brass, iron, metal or cast steel.

Boring comes next in turn, and for variety and interest it is bad to beat. From boring out holes 3 inches to cylinders of the latest large type is a far cry. Both new work and old has to be very carefully dealt with; the holes to be as round as possible and with a polished glassy finish. Sometimes one gets old work brought in, such as pumps, small cylinders, bearings of every description, and the requests that accompany these jobs are very interesting; such as, "true the hole up and leave it right for using the 'ard year in, yer knaw."

Then the capstan lathe or turret comes in order and importance. The number of tools and operations on these machines is both interesting and surprising. To watch the operator turning, screwing, drilling and tapping the different articles with surprising rapidity makes one think that surely it is as near human as any machine in the shop.

Last, but not least, in my catalogue, comes the wall-planer. This machine starts at the foundation of things (the bedplate) and with care and pride the worker of this machine endeavors to give a firm and sure base to the whole structure of the engine, making it a job well and truly laid.

Next the cylinders must be made to come right and fit exactly in their places on top of the columns, the columns resting on the machine bedplate. So you see, for the correctness of both the top and bottom of the engine, reliance must be placed on the wall-planer.

I could go on enumerating the jobs done by the machines until one would wonder what other work was necessary, but by careful inquiry you will find that machines and machinists find lots of employment for foremen, chargemen, fitters, turners, millwrights and, in some cases, beltmen and tool-fettlers. The last two named are, as a rule, amiable men, indeed.

I could write lots more to prove my claim, but I think this will be sufficient for so good a trade as ours to convince even the latest apprentice in the shop, that the call of the machines is the call of the best in shipbuilding and engineering.

Yours,

Smith's Dock Company, Ltd. NULLI SECUNDUS.

Strength of Propellers

Analysis Made in Connection With Classification Rules of the American Bureau of Shipping

By Joseph Hecking*

THE propeller is the most vulnerable part of the ship's machinery. Being removed from observation, the improper functioning of its component parts cannot be checked to prevent their complete failure. All failures, whether due to bad workmanship, faulty material or sudden overload conditions, are beyond the control of the engineers, and for this reason the design of the propeller, the selection of its material and the workmanship require the most serious consideration. Only recently a comparatively new vessel lost its propeller in a heavy sea, was driven ashore and became a complete loss.

Materials

By far the greater number of accidents occur to propellers made of cast iron or so-called semi-steel. The blades mostly break at the root of the blade. Where blades break at the tip the cause in all cases is the striking of a floating object.

The fracture of cast iron blades usually shows a good outer skin with a loose graphitic structure of the material at the center. Where no physical test of cast iron is required, it is difficult to decide whether the breakages are due to inferior material or bad workmanship. Even the best grade of iron will develop considerable segregation by inexperienced handling in castings varying in thickness from a knife edge to as much as 12 inches.

Semi-steel is cast iron mixed with some steel shavings. The melting point of cast iron is in the vicinity of 2,100 degrees F. and of steel 2,600 degrees F. This fact should advise extreme caution in making and using this mixture. Broken blades have shown improper amalgamation of the two metals, evidently due to the fact that the steel had been added in the ladle instead of in the crucible.

Cast steel is claimed to be the best material for vessels running in ice. The cheapness of the material compared with bronze is most probably the father of this belief, since the tenacity of steel is not greater than manganese bronze and is lacking the latter's ductility. Cast steel is also subject to considerable pitting, especially in tropical waters, and for this reason no full advantage is generally taken of its great strength.

Manganese bronze has strength and ductility, is not subject to corrosion and pitting and is beyond doubt the most suitable material for all blades. Blades of this material are more apt to bend than to break under sudden overloads.

The minimum tensile strength of the above materials as required by the American Bureau of Shipping is as follows:

Cast Iron	20,000	pounds per square inch
Semi-Steel	28,000	" " " "
Cast Steel	58,000	" " " "
Manganese Bronze	60,000	" " " "

Strength Calculations

Owing to the excellent analysis of Admiral D. W. Taylor and the indefatigable investigations of Admiral C. W. Dyson, the design of the present day propeller follows certain well-defined lines and freak designs are rare. The strength calculations used by these authorities are rather laborious and are correct and complete within the scope of the general assumption entering into propeller calculations such as uniform strength of material, uniform load and speed conditions and standard section moduli. Inasmuch as this method forms the basis and a check of the empirical formulæ further on proposed it may be well to give a synopsis of the same for the benefit of those not familiar with this method.

*Engineer Surveyor, Scientific Department, American Bureau of Shipping.

Taylor's Analysis

There are two forces acting on the surface of the blade, the thrust P in the direction of the shaft and the torque T at right angles to the shaft (see Fig. 1). These two forces are

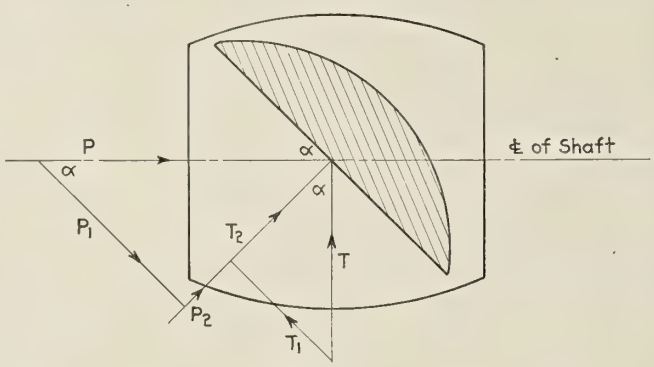


Fig. 1

resolved into their components perpendicular and parallel to the face of the blade. The forces perpendicular to the blade are the torque T_2 and the thrust P_2. The sum of the two forces acts on the face of the blade with m-n as the neutral axis, causing tension strains in section $AmnB$ and compression strains in section mCn (see Fig. 2). The forces parallel to the blade are the thrust P_1 and the torque T_1. These two forces act in opposite directions in line with the face of the

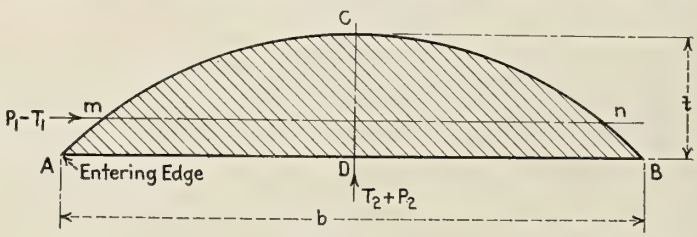


Fig. 2

blade and the difference between the two $(P_1 - T_1)$ with CD as axis causes tension strain in part ACD and compression strain in part BCD. The greatest compression strain is therefore at C, due to $P_2 + T_2$, and the greatest tension strain is at A, due to $(P_2 + T_2) + (P_1 - T_1)$. The tension strain at B, due to $P_2 + T_2$, is partly relieved by the compression strain due to $P_1 - T_1$.

The component forces of P and T may be obtained by trigonometry, thus:

$$\left.\begin{aligned} T_1 &= \sin\alpha \times T;\ T_2 = \cos\alpha \times T \\ P_1 &= \cos\alpha \times P;\ P_2 = \sin\alpha \times P \end{aligned}\right\} \text{(A)}$$

Angle α is the angle of the face of the blade with the centerline of the shaft at a distance from the centerline of 0.125D. The value of 0.125 x diameter of propeller has been taken in this analysis as an average value for the purpose of standardization.

$$\tan \alpha = \frac{2\pi \times .125D}{H} = \frac{.7854D}{H} \quad (1)$$

where D = diameter, H = pitch } of propeller in feet or inches

The magnitude of the torque T per blade is

$$T = \frac{12 \times 33000 \times \text{S.H.P.} \times (.92 \text{ I.H.P.})}{2\pi \times \text{Rev.} \times \text{No. (blades)}} = \frac{63000 \times \text{S.H.P.}}{\text{Rev.} \times \text{No. (blades)}} \quad (2)$$

The magnitude of the effective thrust P per blade, based on a maximum propulsive coefficient of .7 S.H.P., is

$$P = \frac{33000 \times .7 \text{ S.H.P.} \times 60}{\text{Knots} \times 6080 \times \text{No. (blades)}} = \frac{228 \times \text{S.H.P.}}{\text{Knots} \times \text{No. (blades)}} \quad (3)$$

While a propulsive coefficient of 0.7 shaft horsepower may rarely be obtained it should be taken as a matter of safety in order to compensate for occasional forced speed loads.

The mean torque arm about the section at 0.125D is 0.31D — 0.125D = 0.185D and the strains due to torque T_1 and T_2 at this section are $\frac{T_1 \times 0.185D}{0.31D}$ or $0.596T_1$ and $\frac{T_2 \times 0.185D}{0.31D}$ or $0.596T_2$ (D in inches) (Fig. 3).

The mean thrust arm about 0.125D is 0.345D — 0.125D = 0.22D. The strains due to thrust are 0.22D x P_1 and 0.22 x P_2.

The above moments apply strictly to the elliptical form of blade only. Where the form departs materially from the elliptical, modifications must be made to the arms. For broad tip or fan shape blades, the equivalent or the design diameter of the blade must be substituted for actual diameter.

The magnitude of the moments of forces T_1, T_2, P_1 and P_2 may be obtained by a combination of the formulæ A, 2 and 3 as follows:

$$\left.\begin{aligned}
\text{Moment of } T_1 &= \frac{63000 \times \text{S.H.P.} \times \sin\alpha \times .596}{\text{Rev.} \times \text{No. of blades}} = \frac{37500 \times \text{S.H.P.} \times \sin\alpha}{\text{Rev.} \times \text{No. of blades}} \\
\text{Moment of } T_2 &= \frac{37500 \times \text{S.H.P.} \times \cos\alpha}{\text{Rev.} \times \text{No. of blades}} \\
\text{Moment of } P_1 &= \frac{228 \times \text{S.H.P.} \times \cos\alpha \times .22D}{\text{Knots} \times \text{No. of blades}} = \frac{\text{S.H.P.} \times \cos\alpha \times 50D}{\text{Knots} \times \text{No. of blades}} \\
\text{Moment of } P_2 &= \frac{\text{S.H.P.} \times \sin\alpha \times 50D}{\text{Knots} \times \text{No. of blades}}
\end{aligned}\right\} \quad (4)$$

The moment of resistance of the blade section is figured on the basis of a parabola (Fig. 2). For axis *mn* the section modulus for *m n B A* under tension strain is $\frac{bt^2}{8.75}$ and for *mCn* under compression strain is $\frac{bt^2}{13.125}$. For axis *CD* the section modulus for *ACB* is $\frac{b^2t}{15}$ where the half toward *A* is under tension and the half toward *B* under compression. *b* and *t* represent the breadth and the thickness of the blade in inches at a radius of 0.125D from the centerline of the shaft.

In addition to the stresses due to thrust *P* and torque *T* those due to the centrifugal force must be considered. The centrifugal force F_c produces uniform tension strain over the whole blade section equal to $\frac{F_c}{b \times .67\ t}$. Excepting propellers of a high number of revolutions this strain is comparatively small and may be neglected. Where the blades are raked additional stresses are produced due to the moment of the centrifugal force (Fig. 3) and these must be considered in the calculations for strength.

The centrifugal force is calculated by the formula:

$$F_c = \frac{W \times v^2}{r \times 32.16}\ ;\ v = 2\ r\ \pi \times R_s \quad (5)$$

Where W = weight of blade outside of radius of 0.125D, in pounds.
v = velocity in feet per second at center of gravity.
r = radius of center of gravity of blade in feet from centerline of shaft.
R_s = revolutions per second.

In view of the fact that blades rake straight aft, the centrifugal force should be resolved into its components similar to thrust *P* (Fig. 1), but no grave error is committed

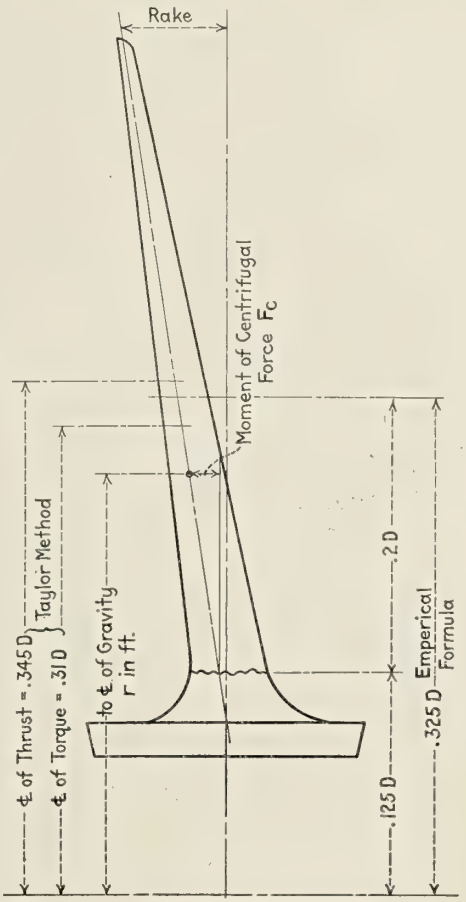


Fig. 3

by assuming the total centrifugal force to act perpendicular to the blade, since both components will cause tension strain at *A*. The tension strain at *A* due to thrust and torque is therefore increased by $\frac{\text{moment of } F_c \times 8.75}{b \times t^2}$ and the compression strain at *C* is increased by about $\frac{\text{moment of } F_c \times 13.125}{b \times t^2} \times .7$ (6)

In view of the fact that the material, with the possible exception of cast steel, is considerably stronger in compression than in tension, it will suffice to solve for tension stresses only.

Example

An example of the process of the complete calculations is given herewith.

Propeller 4-bladed, built-up, 17 feet diameter, 15 feet pitch, 2,575 shaft horsepower. 82 revolutions per minute, 10½ knots, breadth b = 29 inches, thickness t = 6.07 inches, tan angle $\alpha = \frac{.7854 \times 17}{15} = .89$; cos $\alpha = .747$; sin $\alpha = .665$, weight of one blade 2,460 pounds.

$$\text{Moment of } T_1 = \frac{37500 \times 2575 \times .665}{82 \times 4} = 196{,}000 \text{ inch pounds}$$

$$\text{Moment of } T_2 = \frac{37500 \times 2575 \times .747}{82 \times 4} = 220{,}000 \text{ inch pounds}$$

$$\text{Moment of } P_1 = \frac{2575 \times .747 \times 50 \times 204}{10.5 \times 4} = 468{,}000 \text{ inch pounds}$$

$$\text{Moment of } P_2 = \frac{2575 \times .665 \times 50 \times 204}{10.5 \times 4} = 416{,}000 \text{ inch pounds}$$

$$\text{Moment of } F_c = \frac{2460 \times (6.28 \times 4.67 \times 1.37)^2 \times 6.25}{4.67 \times 32.16} = 165{,}000 \text{ inch pounds}$$

Compression stress at C =

$$S_c = 416000 + 220000 + (.7 \times 165000) \div \frac{.29 \times 6.07^2}{13.125}$$

$$= \frac{751000 \times 13.125}{29 \times 6.07^2} = 9{,}200 \text{ pounds per square inch}$$

Tension stress at A =

$$S_t = (416000 + 220000 + 165000) \div \frac{29 \times 6.07^2}{8.75} + (468000 - 196000) \div \frac{29^2 \times 6.07}{15} =$$

$$\frac{801000 \times 8.75}{29 \times 6.07^2} + \frac{27200 \times 15}{29^2 \times 6.07} = 7370 \text{ pounds per square inch}$$

Empirical Rule

The results obtained by the Taylor method for ordinary merchant vessels with normal revolutions may be arrived at by an empirical formula which has been used at our shipyards. It is assumed that the total shaft horsepower produces a thrust perpendicular to the blade. The load per blade $L = \frac{\text{S.H.P.} \times 33000 \times 12}{\text{H (inch)} \times \text{Rev.} \times \text{No.}}$ (7). The load arm is variously taken, but for the purpose of standardization the same may be considered to be $0.325D$ from the center of the shaft (Fig. 3). The point of maximum strain may also in

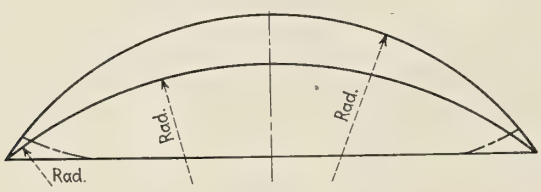


Fig. 4

this case be taken at $0.125D$ from the center so that the moment of L is $0.325D - 0.125D = 0.2D$.

The cross section of cast iron blades at $0.125D$ takes the form of a segment of a circle (Fig. 4). Thinner blades of cast steel and bronze are formed with a radius at the edges. According to Dyson the cutting away of the blade at the driving side, as shown in dot and dash, is a useless refinement. In any case a section modulus of $\frac{t^2 b}{12}$ is considered sufficiently correct for all practical purposes. If S represents the fibre stress at the radius of $0.125D$, then

$$\frac{t^2 b}{12} S = \frac{\text{S.H.P.} \times 33000 \times 12 \times .2D}{\text{H} \times \text{R} \times \text{No.}}$$

$$S = \frac{\text{S.H.P.} \times 950000 \times D}{\text{H} \times \text{R} \times \text{No.} \times t^2 \times b} \quad (8)$$

where D and H are the diameter and pitch of the propeller in inches.

Or, if f_p is the allowable fibre stress of the blade material

$$t^2 = \frac{\text{S.H.P.} \times 950000 \times D}{\text{H} \times \text{Rev.} \times \text{No.} \times b \times f_p} \quad (9)$$

Comparison of Formulae

The results of formula (8) have been carefully checked with the Taylor formula on about 30 different designs and a

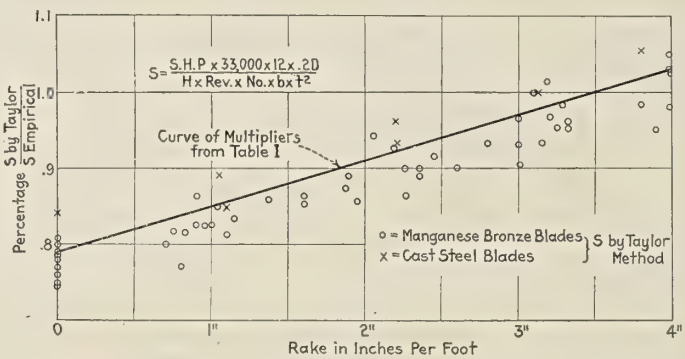


Fig. 5

comparison is shown in the curves, Figs. 5 and 6. The 1.0 line in both cases represents the value for S obtained by the above empirical formula (8), while the o and x points rep-

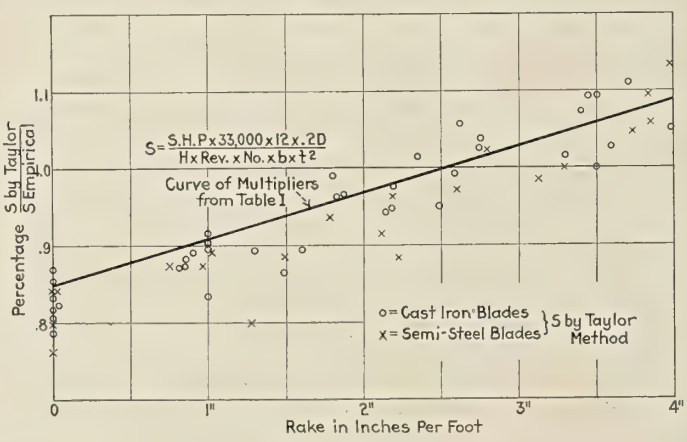


Fig. 6

resent the values obtained by the Taylor method. It is evident that a correction should be made to the value of S depending on the rake, and the curves running diagonally through the o and x have been taken as safe average values. The correction factors for the values of S in formula (8) or of t^2 in formula (9), as taken from the curves are therefore as follows:

Table I

Rake in inches per ft.	0	½	1	1½	2	2½	3	3½	4
Cast iron and semi-steel	.85	.88	.91	.94	.97	1.0	1.03	1.06	1.09
Cast steel and manganese bronze	.79	.82	.85	.88	.91	.94	.97	1	1.03

PROPELLER THICKNESS BASED ON DIAMETER OF PROPELLER SHAFT

In view of the fact that the shaft diameters are always determined before the propeller is designed, the thickness of the blade may be based on the diameter of the propeller shaft. The rules of the American Bureau of Shipping require that the diameter of the line shaft d_1 of constant torque or rotary engines and motors shall be determined by the formula

$$d_1 = \sqrt[3]{\frac{\text{H.P.} \times 65}{\text{Rev.}}} \quad (10)$$

This formula is derived from the twisting moment formula

$$M_t = \frac{12 \times \text{H.P.} \times 33000}{2\pi \times \text{Rev.}} = .196 d^3 f,$$

where f represents a working stress of 5,000 pounds per square inch.

$$d^3_1 = \frac{12 \times \text{H.P.} \times 33000}{2\pi \times \text{Rev.} \times .196 \times 5000} = \frac{\text{H.P.} \times 65}{\text{Rev.}} \text{ (Approx.)}$$

The diameter of the propeller shaft d_p is required to be 1.1 times the diameter of the line shaft, or

$$d^3_p = \frac{\text{H.P.} \times 65 \times 1.1^3}{\text{Rev.}} = \frac{\text{H.P.} \times 86}{\text{Rev.}} \quad (11)$$

The relation between t^2 and d^3_p for constant torque engines, where the correction factor according to Table I, is 1, is

$$\frac{t^2}{d^3_p} = \frac{\text{H.P.} \times 950000 \times D \times R}{H \times R \times \text{No.} \times b \times f_p \times \text{H.P.} \times 86} = \frac{11000 \times D}{H \times \text{No.} \times b \times f_p}$$

$$t^2 = \frac{11000 \times D \times d^3_p}{H \times \text{No.} \times b \times f_p} \quad (12)$$

ALLOWABLE WORKING STRESSES

Experience has shown that the following fibre stresses at the root of the blade should not be exceeded:

$f_p = 2{,}750$ pounds per square inch for cast iron
$= 3{,}600$ " " " " " semi-steel
$= 5{,}200$ " " " " " cast steel
$= 6{,}200$ " " " " " manganese bronze

THICKNESS OF BLADES

On the basis of these working stresses formula (12) will give a thickness of blades at a radius of $0.125D$, where the correction factor in Table I is 1, as follows *for turbines and motors:*

Cast Iron—Rake 2½ inches per foot

$$t = \sqrt{\frac{11000 \times D \times d^3_p}{P \times \text{No.} \times b \times 2750}} = 2\sqrt{\frac{D \times d^3_p}{P \times \text{No.} \times b}}$$

Semi-steel—Rake 2½ inches per foot

$$t = \sqrt{\frac{11000 \times D \times d^3_p}{H \times \text{No.} \times b \times 3600}} = 1.75\sqrt{\frac{D \times d^3_p}{H \times \text{No.} \times b}}$$

Cast steel—Rake 3½ inches per foot

$$t = 1.45\sqrt{\frac{D \times d^3_p}{H \times \text{No.} \times b}}$$

Manganese Bronze—Rake 3½ inches per foot

$$t = 1.34\sqrt{\frac{D \times d^3_p}{H \times \text{No.} \times b}} \quad (13)$$

RECIPROCATING ENGINES

Reciprocating engines have an irregular turning effort; the ratio of maximum to mean turning effort varies from 1.8 for compound engines to about 1.2 for balanced quadruple expansion engines. The value of maximum to mean turning effort has been taken as 1.25, which is expected safely to cover ordinary merchant triple and quadruple expansion engines. The maximum turning effort for which the propeller shaft is

DATA SHEET

| SHIP | | | | | | | ENGINE | | | | | PROPELLER | | | | | | |

designed equals 1.25 times the turning effort of rotary engines or

$$d^3_p = \frac{\text{H.P.} \times 86 \times 1.25}{R} = \frac{\text{H.P.} \times 107}{R} \quad (14)$$

The force acting perpendicular to the blade is composed of thrust, torque and centrifugal force and may be considered uniform. The relation between t^2 and d^3_p for reciprocating engines is therefore

$$\frac{t^2}{d^3_p} = \frac{\text{H.P.} \times 950000 \times D \times R}{H \times R \times \text{No.} \times b \times f_p \times \text{H.P.} \times 107} = \frac{8900 \times D}{H \times \text{No.} \times b \times f_p}$$

$$t^2 = \frac{8900 \times D \times d^3_p}{H \times R \times \text{No.} \times b \times f_p} \quad (15)$$

Inserting the fibre stresses f_p as before, the thickness of blades for reciprocating engines, where the correction factor in Table I is 1, is

Cast iron—Rake 2½ inches per foot

$$t = \sqrt{\frac{8900 \times D \times d^3_p}{H \times \text{No.} \times b \times 2750}} = 1.8 \sqrt{\frac{D \times d^3_p}{H \times \text{No.} \times b}}$$

Semi-steel—Rake 2½ inches per foot

$$t = \sqrt{\frac{8900 \times D \times d^3_p}{H \times \text{No.} \times b \times 3600}} = 1.57 \sqrt{\frac{D \times d^3_p}{H \times \text{No.} \times b}}$$

Cast steel—Rake 3½ inches per foot

$$t = 1.31 \sqrt{\frac{D \times d^3_p}{H \times \text{No.} \times b}}$$

Manganese bronze—Rake 3½ inches per foot

$$t = 1.2 \sqrt{\frac{D \times d^3_p}{H \times \text{No.} \times b}} \quad (16)$$

For determining the thickness of blades of various rakes, the values of t^2 in formula (12) for turbines and motors, and in formula (15) for reciprocating engines, are to be multiplied by the factors in Table I depending on the rake of the propeller. Taking as an example a cast steel propeller with a rake of 1½ inches per foot for a reciprocating engine correction factor, Table I = .88, inserted in formula (15) gives

$$t^2 = \frac{8900 \times D \times d^3_p \times .88}{H \times R \times \text{No.} \times b \times 5200} = \frac{1.5 \times D \times d^3_p}{H \times R \times \text{No.} \times b}$$

$$t = 1.23 \sqrt{\frac{D \times d^3_p}{H \times R \times \text{No.} \times b}} \quad (17)$$

The numerical value before the root has been found by this method for various materials and rakes and is tabulated as "*C*" in the following:

from the neutral axis expressed in terms of the pitch circle (r) is about 0.4 r. The moment of resistance of the studs is therefore $a \times n \times 0.4\ r \times f_b$, where

a = area of one stud at bottom of thread
n = number of studs on driving side of blade
r = diameter of pitch circle in inches
f_b = fibre stress = 4,500 pounds per square inch.

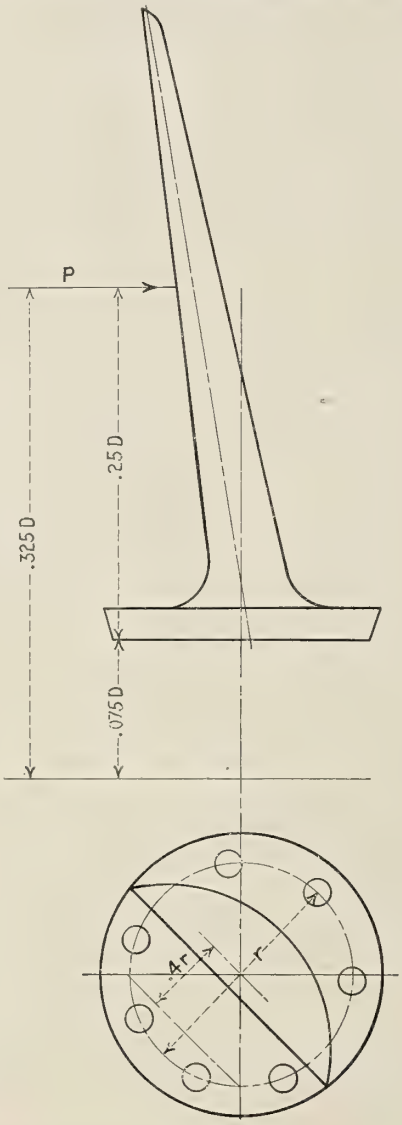


Fig. 7

Table II.—*Values of C*

Rake of Blade, Inches Per Foot	Cast Iron Engines		Semi-Steel Engines		Cast Steel Engines		Manganese Bronze Engines	
	Rotary	Recip.	Rotary	Recip.	Rotary	Recip.	Rotary	Recip.
0	1.85	1.66	1.61	1.45	1.29	1.17	1.19	1.07
½	1.88	1.69	1.64	1.48	1.32	1.19	1.21	1.09
1	1.91	1.72	1.67	1.50	1.34	1.21	1.23	1.11
1½	1.94	1.75	1.70	1.53	1.36	1.23	1.25	1.12
2	1.97	1.77	1.72	1.55	1.39	1.25	1.27	1.14
2½	2.00	1.80	1.75	1.57	1.41	1.27	1.29	1.16
3	2.03	1.83	1.78	1.60	1.43	1.29	1.31	1.18
3½	2.06	1.86	1.80	1 62	1.46	1.31	1.33	1.2
4	2.09	1.89	1.82	1.64	1.48	1.33	1.35	1.22

Studs (Fig. 7)

The thrust P exerts a bending moment of $P \times 0.25\ D$ at the joint between hub and flange. The half of the flange opposite P is under compression and the studs in this half are not subject to stress. The half on the side of P is in tension and the studs are therefore in tension. In most cases four studs are fitted on this side and the average distance

The bending moment due to thrust at the joint equals

$$P \times .25D = \frac{\text{H.P.} \times 33000 \times 12 \times 0.25D}{H \times R \times N} = a \times n \times 0.4r \times 4500$$

$$a = \frac{\text{H.P.} \times 33000 \times 12 \times 0.25D}{H \times R \times N \times n \times 0.4r \times 4500} = \frac{55 \times \text{H.P.} \times D}{H \times R \times N \times n \times r}$$

According to formulae (11) and (14) the average value of

$$d^3_p = \frac{H.P. \times (86 + 107)}{R \times 2} = \frac{H.P. \times 96.5}{R}, \text{ say } \frac{H.P. \times 100}{R}$$

The relation of "a" to d^3_p is

$$\frac{a}{d^3_p} = \frac{55 \times H.P. \times D \times R}{H \times R \times N \times n \times r \times H.P. \times 100} = \frac{0.55D}{H \times N \times n \times r}$$

$$a = \frac{0.55D \times d^3_p}{H \times N \times n \times r} \quad (18)$$

The power in reversing the engine is not greater than ¾ of the ahead power, and where the number of bolts on the forward half of the flange is ¾ of the bolts in the after half, the joint may be considered of equal strength.

Turret Rotary Shear for Cutting Metal Without Swinging the Stock

FOR cutting various shapes from sheet metal without turning the sheet or plate during the cut, the Southwark Foundry and Machine Company, Philadelphia, Pa., has produced a turret rotary shear, which cuts an opening up to double the throat depth at any distance from the end of the sheets or plates regardless of their length. Four sizes of this machine are available, having capacities up to ⅜-inch gage metal, but larger sizes are also built having shearing capacities up to 1-inch plate. The No. 3 Southwark-Gray

No. 3 Southwark-Gray Double Turret Rotary Shear

shear illustrated is of special interest because of the double turret with which it is equipped.

As stock is fed through the machine, the line to be cut is followed by means of the turret which may be revolved by guide wheels on either side of the machine. Cuts are made with minimum radii, equal to the radius of the cutters in stock not heavier than half the capacity of the machine, while on heavier stock than this the minimum radii will be slightly larger than the radius of the cutters. On the double turret machine for material ⅜-inch thick and heavier, both the upper and lower cutters are at an angle, which is unchanged in whatever position the turret may be turned by the hand wheel. When the position of the cutters is changed, the direction of the feed is correspondingly changed, insuring automatic feeding of materials at all times. Foot treads are provided on each side of the machine which control the cutters, so that when difficult cuts are being made, the cutters may be started or stopped within a fraction of an inch.

In starting an inside cut, sufficient pressure is provided to force the cutters through the sheet or plate before the cut is commenced. Horizontal and vertical adjustments are provided to insure correct alinement of the cutting edges without the cutters coming together and jamming.

In general sheet metal work the shear may be used to advantage cutting elbows, tees, hoods, dust collectors, blower piping, gaskets, liners, templates, ventilator work, shear plates for ship, boiler and tank work, and the like.

Triple Expansion Engine Designed for Ships of 10,000 to 12,000 Deadweight Tons

THE Hamilton 3,200 indicated horsepower triple expansion marine engine, built by The Hooven, Owens, Rentschler Company, Hamilton, O., is designed to propel ships of from 10,000 to 12,000 tons deadweight at an average speed of 10½ knots. Triple expansion engines have reached a high state of development and as they are manufactured by numerous firms they will, of course, have variations in design but the following data represent good practice values which are interesting for comparative purposes:

Salient Characteristics

1.	Diameter high pressure cylinder	27½ inches
2.	Diameter intermediate pressure cylinder	46 inches
3.	Diameter low pressure cylinder	78 inches
4.	Length of stroke	51 inches
5.	Steam pressure at throttle	210 pounds
6.	Revolutions per minute	75
7.	Piston speed, feet per minute	638
8.	Indicated horsepower	3,200
9.	Diameter crankshaft	16 inches
10.	Diameter and length main bearing	16 by 16 inches
11.	Diameter and length crankpin	16¼ by 15¾ inches
12.	Diameter and length crosshead pin	8 by 8½ inches
13.	Length of centers connecting rod	114 inches
14.	Diameter connecting rod, top and bottom	6½-7½ inches
15.	Length and width crosshead slipper	30 by 16 inches
16.	Diameter high pressure valve, top and bottom	12-11½ inches
17.	Diameter intermediate pressure valve, top and bottom,	24½-24 inches
18.	Diameter valve stem, through stuffing box and guide,	4-4½ inches
19.	Diameter piston rod, through stuffing box	7¼ inches
20.	Lineal clearance, top and bottom	½-⅝ inches
21.	Diameter steam pipe	9 inches
22.	Diameter exhaust pipe	27 inches
23.	Diameter and length link block pin	4½ by 4¼ inches
24.	Diameter and width eccentrics	29¾-44 by 5 inches
25.	Diameter and length eccentric rod pin	3½ by 3½ inches
26.	Diameter eccentric rod, top and bottom	3½-4½ inches
27.	Diameter and length drag link pin	2½ by 2⅝ inches
28.	Width and height link bar	1¾ by 5½ inches
29.	Diameter and stroke reverse engine	14 by 24 inches
30.	Diameter reverse shaft	7 inches
31.	Diameter and stroke air pump	28 by 24 inches
32.	Diameter and stroke bilge pumps (2)	5 by 24 inches
33.	Diameter and stroke turning engine	8 by 6 inches
34.	Diameter thrust shaft	16 inches
35.	Diameter and number collars	24½ inches-12
36.	Thickness thrust collar	2½ inches
37.	Diameter and number coupling bolts	3¾ inches-6

View Showing Four Shipping Board Vessels, Representing an Investment by the American People of $27,000,000, Discharging Are Engaged in the New Passenger and Freight Service Between Puget Sound and the Orient. They are, Rin

American Shipping Gaining Strong Position in North Trans-Pacific Commerce

WHEN, early in July, four large United States Shipping Board vessels lay at one time at Pier B, of the Port of Seattle, the largest commercial wharf in the world, a graphic picture was presented of the rapid progress being made in the effort to win ascendency for the American flag in the commerce of the North Pacific, via the Great Circle trade route to and from the Orient. The mammoth terminal, constructed by Seattle at a cost of more than $5,000,000, is justifying the faith of its builders by becoming the home berth of an increasing fleet of American ships engaged in trans-Pacific commerce.

American Terminus of Admiral Line

Pier B, of the great terminal is being used as the American terminus of the Admiral Line, which inaugurated the all-American passenger and freight service between Puget Sound and Oriental ports, with the sailing of the *Wenatchee* on April 9, followed by the *Silver State* on July 9. The four ships which lay at Pier B were the passenger and freight liners *Wenatchee, Keystone State* and *Silver State* and the freighter *Edmore,* all Shipping Board vessels allocated to the Admiral Line for operation. They represent an investment by the people of the United States of $27,000,000.

Pier Cost $2,500,000

It is expected that additional vessels will be allocated to the Admiral Line for this service, making the capacity for passengers and freight of the American line far greater than that of any of its foreign competitors which, in the past, have carried the bulk of American commerce out of Puget Sound. The vessels which have so far sailed in the service have carried large cargoes, encouraging the belief of Admiral Line officials that American ships can gain control of the trans-Pacific passenger and freight business originating in the United States, which constitutes the bulk of the traffic.

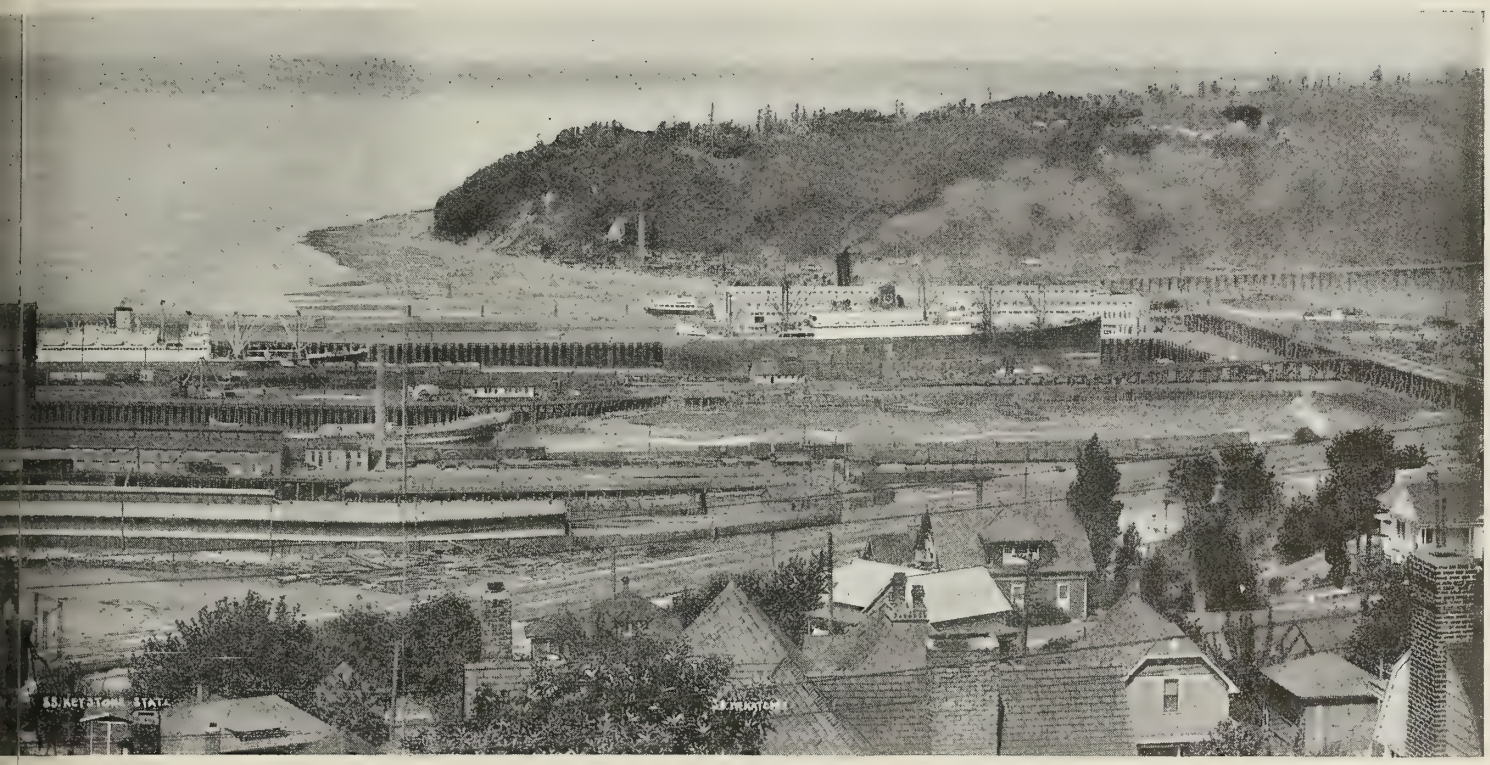
Pier B, which can accommodate many more than the four large vessels shown in the picture, was recently completed at a cost of $2,500,000. It is 2,500 feet long and 365 feet wide, larger in area than Pier A, the first constructed, which is 2,540 feet long by 310 feet wide. The piers are equipped with transit sheds and modern machinery, insuring rapid and economical handling of cargo and giving American ships a decided advantage in this respect over Canadian and British ships in British Columbia ports.

With a splendid fleet, to be still further augmented, and the best terminal facilities in the world, the Admiral Line looks for rapid realization of its purpose to gain ascendency for the American flag on the Great Circle trade route.

Hoover Reorganizes the Foreign Trade Service of the Department of Commerce

AS part of the general reorganization plan of the foreign trade service, upon which Secretary Hoover has been engaged ever since he became the head of the Department of Commerce last March, for the purpose of placing the facilities and influence of the department behind the various movements to build up American overseas trade, the department has announced during the past month a number of important steps in the reorganization of the Bureau of Foreign and Domestic Commerce. The bureau is being reorganized on a commodity basis, the object of which, according to the announcement by Secretary Hoover, is threefold, as follows:

1. That specialists in the different great industrial divisions should be incorporated in the bureau for the purpose of giving expert direction to the staff of 600 foreign agents, including commercial attaches, consular officers, trade commissioners and special agents, as to the investigations and service that will be of importance and most useful to their particular branch of industry.
2. That they may, by maintaining close communication



Loading at Pier B of the $5,000,000 Terminal of the Port of Seattle. The Four Vessels, Allocated to the Admiral Line, eft, the Passenger and Freight Liners Wenatchee, Keystone State and Silver State and the Freighter Edmore

with trade associations in different industries, keep in touch with the character of service, information and investigation needed in these industries.

3. That the material in the way of information coming in from these various agents may be edited and prepared in such a manner as to be of the most practicable service.

Directors Appointed for Commodity Divisions

The following commodity divisions have so far been established: Iron and steel, lumber, industrial machinery, electrical equipment and supplies, foodstuffs, automotive equipment, fuels, textiles, shoes and leather products, agricultural implements and vehicles, rubber products. Announcements have also been made from time to time during the past few weeks of the appointment of the men who have been placed in charge of these divisions, who have been chosen from the industries themselves and in most instances have been selected in cooperation with the trade associations representing the different industries so that they may bring to the department not only specialized knowledge and sympathetic understanding of the problems of these particular industrial groups, but that they also in turn may interpret to the members of the foreign staff the exact needs of these industries in this country and develop the information received in such form as may be of the greatest use in the industry to which it is related. The heads of the various divisions are expected to keep in close touch with the centers of the various industries through the trade associations, through trade papers and through the producers and dealers individually so as to ascertain the exact nature of official assistance most urgently needed or which will be most generally useful.

A Transportation Division Established

In addition to the commodity divisions, there has been created within the bureau a new transportation division, of which E. S. Gregg, formerly of Galveston, Texas, and more recently of New York City, has been appointed chief. This division is to help American business men in their overseas work in so far as it relates to transportation and the movement of freight by land or sea. Mr. Gregg is a graduate of Austin College, Texas, where he received an A. B. degree, and he also took a graduate course in transportation at the University of Chicago. During the war he was connected with the shipping section of the general staff of the War Department. Since the war he has been associated with the American International Corporation as adviser on shipping conditions. He is also the author of numerous articles on shipping subjects.

Mr. Gregg says that the first work to be undertaken will be an intensive study of ocean shipping with a view to determining the minimum amount of shipping tonnage needed for given ports of the United States and in connection with the maintenance of established trade routes and the establishment of new routes. He will work in close cooperation with the Shipping Board. Later he expects to give consideration to matters relating to export rail rates and may cooperate with industries who are interested in seeking the establishment of such rates.

Commerce Reports Changed to a Weekly Magazine

As a part of the general plan of making the foreign trade service more directly useful, the *Commerce Reports*, which have been issued by the department for years daily, have been changed to a weekly publication beginning with September 5. It is proposed to place information with regard to foreign trade before American business men in more intelligible and constructive form.

Indicator Locking Device

A DEVICE for automatically locking a mechanically operated shaft in any determined position or point has been developed by Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne, England. The device is used for locking ships' watertight doors in a closed or open position; for attachment to any class of hand operated door where a shaft can be utilized for the purpose of controlling traffic or exits from public places; or for attaching to sluice valves where a definite opening is essential to ensure a certain rate of flow of the liquid passing. In the latter case, the opening giving the required rate of flow having been

View Showing Four Shipping Board Vessels, Representing an Investment by the American People of $27,000,000, Discharging and Loading at Pier B of the $5,000,000 Terminal of the Port of Seattle. The Four Vessels, Allocated to the Admiral Line, Are Engaged in the New Passenger and Freight Service Between Puget Sound and the Orient. They are, Right to Left, the Passenger and Freight Liners Wenatchee, Keystone State and Silver State and the Freighter Edmore

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Pier Cost $2,500,000

It is expected that additional vessels will be allocated to the Admiral Line for this service, making the capacity for passengers and freight of the American line far greater than that of any of its foreign competitors which, in the past, have carried the bulk of American commerce out of Puget Sound. The vessels which have so far sailed in the service have carried large cargoes, encouraging the belief of Admiral Line officials that American ships can gain control of the trans-Pacific passenger and freight business originating in the United States, which constitutes the bulk of the traffic.

Pier B, which can accommodate many more than the four large vessels shown in the picture, was recently completed at a cost of $2,500,000. It is 2,500 feet long and 365 feet wide, larger in area than Pier A, the first constructed, which is 2,540 feet long by 310 feet wide. The piers are equipped with transit sheds and modern machinery, insuring rapid and economical handling of cargo and giving American ships a decided advantage in this respect over Canadian and British ships in British Columbia ports.

With a splendid fleet, to be still further augmented, and the best terminal facilities in the world, the Admiral Line looks for rapid realization of its purpose to gain ascendency for the American flag on the Great Circle trade route.

Hoover Reorganizes the Foreign Trade Service of the Department of Commerce

AS part of the general reorganization plan of the foreign trade service, upon which Secretary Hoover has been engaged ever since he became the head of the Department of Commerce last March, for the purpose of placing the facilities and influence of the department behind the various movements to build up American overseas trade, the department has announced during the past month a number of important steps in the reorganization of the Bureau of Foreign and Domestic Commerce. The bureau is being reorganized on a commodity basis, the object of which, according to the announcement by Secretary Hoover, is threefold, as follows:

1. That specialists in the different great industrial divisions should be incorporated in the bureau for the purpose of giving expert direction to the staff of 600 foreign agents, including commercial attaches, consular officers, trade commissioners and special agents, as to the investigations and service that will be of importance and most useful to their particular branch of industry.

2. That they may, by maintaining close communication with trade associations in different industries, keep in touch with the character of service, information and investigation needed in these industries.

3. That the material in the way of information coming in from these various agents may be edited and prepared in such a manner as to be of the most practicable service.

Directors Appointed for Commodity Divisions

The following commodity divisions have so far been established: Iron and steel, lumber, industrial machinery, electrical equipment and supplies, foodstuffs, automotive equipment, fuels, textiles, shoes and leather products, agricultural implements and vehicles, rubber products. Announcements have also been made from time to time during the past few weeks of the appointment of the men who have been placed in charge of these divisions, who have been chosen from the industries themselves and in most instances have been selected in cooperation with the trade associations representing the different industries so that they may bring to the department not only specialized knowledge and sympathetic understanding of the problems of these particular industrial groups, but that they also in turn may interpret to the members of the foreign staff the exact needs of these industries in this country and develop the information received in such form as may be of the greatest use in the industry to which it is related. The heads of the various divisions are expected to keep in close touch with the centers of the various industries through the trade associations, through trade papers and through the producers and dealers individually so as to ascertain the exact nature of official assistance most urgently needed or which will be most generally useful.

A Transportation Division Established

In addition to the commodity divisions, there has been created within the bureau a new transportation division, of which E. S. Gregg, formerly of Galveston, Texas, and more recently of New York City, has been appointed chief. This division is to help American business men in their overseas work in so far as it relates to transportation and the movement of freight by land or sea. Mr. Gregg is a graduate of Austin College, Texas, where he received an A. B. degree, and he also took a graduate course in transportation at the University of Chicago. During the war he was connected with the shipping section of the general staff of the War Department. Since the war he has been associated with the American International Corporation as adviser on shipping conditions. He is also the author of numerous articles on shipping subjects.

Mr. Gregg says that the first work to be undertaken will be an intensive study of ocean shipping with a view to determining the minimum amount of shipping tonnage needed for given ports of the United States and in connection with the maintenance of established trade routes and the establishment of new routes. He will work in close cooperation with the Shipping Board. Later he expects to give consideration to matters relating to export rail rates and may cooperate with industries who are interested in seeking the establishment of such rates.

Commerce Reports Changed to a Weekly Magazine

As a part of the general plan of making the foreign trade service more directly useful, the *Commerce Reports,* which have been issued by the department for years daily, have been changed to a weekly publication beginning with September 5. It is proposed to place information with regard to foreign trade before American business men in more intelligible and constructive form.

Indicator Locking Device

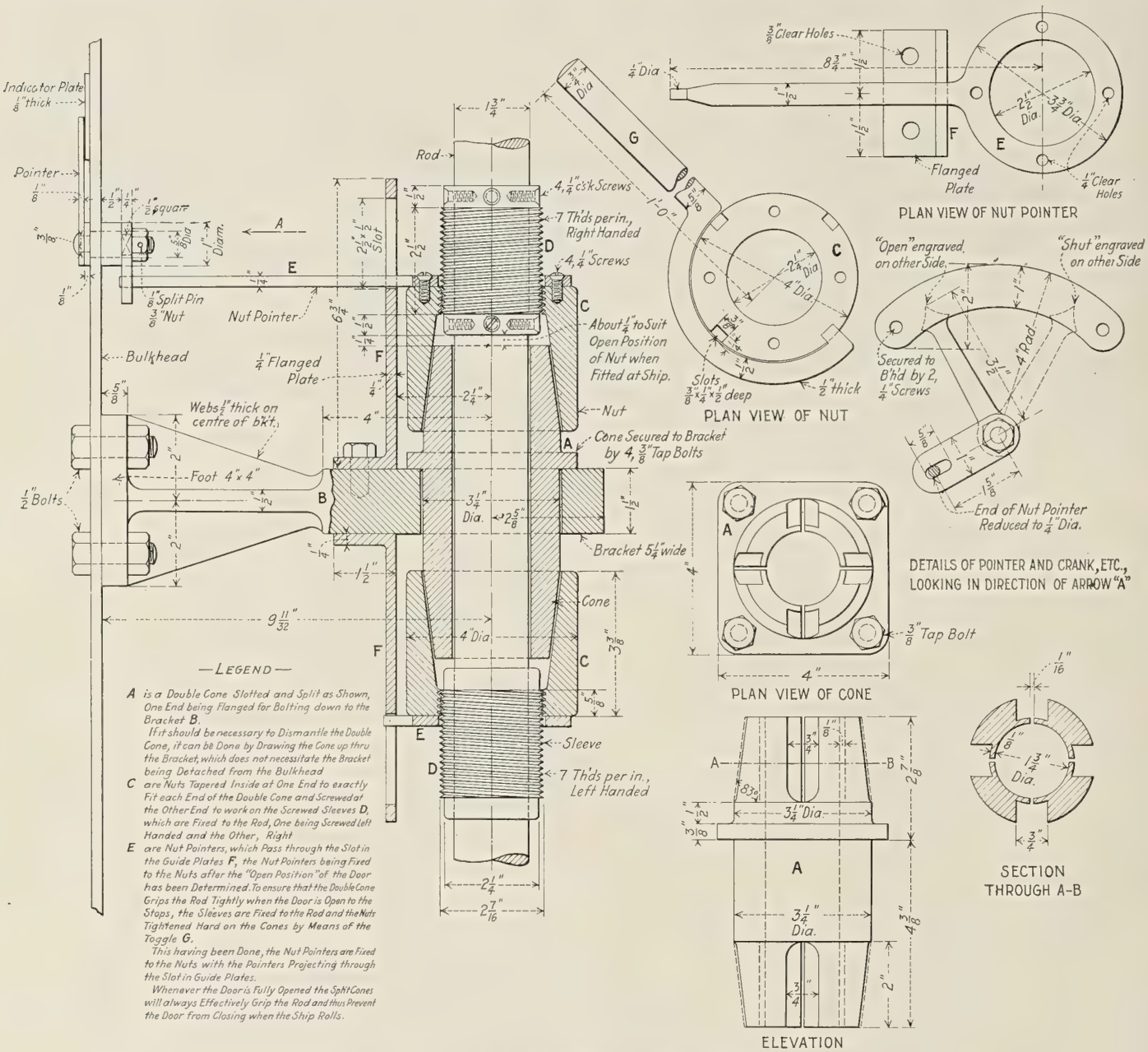
A DEVICE for automatically locking a mechanically operated shaft in any determined position or point has been developed by Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne, England. The device is used for locking ships' watertight doors in a closed or open position; for attachment to any class of hand operated door where a shaft can be utilized for the purpose of controlling traffic or exits from public places; or for attaching to sluice valves where a definite opening is essential to ensure a certain rate of flow of the liquid passing. In the latter case, the opening giving the required rate of flow having been

ascertained, the shaft controlling the operating mechanism can be locked definitely and the indicator plate marked to indicate the rate of flow.

For ships' watertight doors the device is particularly adaptable and can be so applied as to operate on any door so as to lock same in any determined position, or open fully or closed. This operation can be carried out from several decks above the doors or at the door itself as circumstances demand. Once the device is attached it will answer the purpose for which it is set, the synchronizing action of the coned nuts on the split bush as they travel towards each other secures a positive locking action, and at the same time indicates, as previously determined, the actual position of the door on the indicator plate, making it foolproof. The operating lever, which is usually a ratchet, opens or closes the door and locks same in either position as circumstances demand.

It has many times been found urgently necessary to close immediately watertight doors at the point of the door itself but owing to independent locking devices attached to some doors to prevent creeping it could not be accomplished without first detaching the locking arrangement. With this device a person could be fastened in between two bulkheads but he could easily release himself although the doors may have been locked from above to a dead closed position.

The device, where attached, will give a positive locking action. There is no friction in opening or closing a door, where this device is attached, except at the moment when the synchronizing action of the traveling coned nuts make contact with the split sleeve or bush which grips the shaft.


Indicator Plate
Pointer
Rod
Nut Pointer
Bulkhead
Flanged Plate
Webs thick on centre of b'k't
Foot 4" x 4"
Bolts
Nut
Cone Secured to Bracket by 4, Tap Bolts
Bracket wide
Cone
Sleeve
7 Th'ds per in., Right Handed
7 Th'ds per in., Left Handed
Screws
Split Pin
Nut
Clear Holes
Dia.
Flanged Plate
Clear Holes
PLAN VIEW OF NUT POINTER
Slots deep
thick
PLAN VIEW OF NUT
"Open" engraved on other Side
"Shut" engraved on other Side
Secured to B'hd by 2, Screws
Rad.
End of Nut Pointer Reduced to Dia.
DETAILS OF POINTER AND CRANK, ETC., LOOKING IN DIRECTION OF ARROW "A"
Tap Bolt
PLAN VIEW OF CONE
SECTION THROUGH A-B
ELEVATION
—LEGEND—
A is a Double Cone Slotted and Split as Shown, One End being Flanged for Bolting down to the Bracket B.
If it should be necessary to Dismantle the Double Cone, it can be Done by Drawing the Cone up thru the Bracket, which does not necessitate the Bracket being Detached from the Bulkhead
C are Nuts Tapered Inside at One End to exactly Fit each End of the Double Cone and Screwed at the Other End to work on the Screwed Sleeves D, which are Fixed to the Rod, One being Screwed Left Handed and the Other, Right
E are Nut Pointers, which Pass through the Slot in the Guide Plates F, the Nut Pointers being Fixed to the Nuts after the "Open Position" of the Door has been Determined. To ensure that the Double Cone Grips the Rod Tightly when the Door is Open to the Stops, the Sleeves are Fixed to the Rod and the Nuts Tightened Hard on the Cones by Means of the Toggle G.
This having been Done, the Nut Pointers are Fixed to the Nuts with the Pointers Projecting through the Slot in Guide Plates.
Whenever the Door is Fully Opened the Split Cones will always Effectively Grip the Rod and thus Prevent the Door from Closing when the Ship Rolls.

Details of Combined Locking Gear

Annual Index for 1921

Copies of the annual index of MARINE ENGINEERING AND SHIPPING AGE for the year 1921 will be mailed on January 1, 1922, to all of our subscribers who send us a request for it on or before December 1, 1921. As the edition of the index will be limited to the number ordered up to December 1, all readers desiring a copy should send in their orders promptly.

Timbers and Lumber for Shipbuilding Purposes—II

By Horace Holden Thayer*

Continuation of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the classes of workers who have to deal with these materials from the materials point of view.

HAVING briefly considered in a general way the more important factors governing the selection and use of woods for shipbuilding purposes, the writer will present a few facts of interest that have come under his observation regarding the woods already mentioned and some others that have not yet been referred to.

Ash

The ash of particular value for use about a ship is White Ash, which is very strong, tough and elastic. The second growth Ash, which is the strongest and heaviest, weighs when seasoned about 44 pounds per cubic foot. Such articles as oars and boat hooks should be specified to be of best quality White Ash. It is a valuable wood for accommodation ladders, outside wood ladders generally and Jacob's ladders, also for wood gratings and grab rails. It is also used for doors of refrigerated rooms and the door casings. Other joinerwork uses for which this wood is particularly suitable are dressers, tables and benches, dish racks, drain, dough, chopping and bread boards, and stern and side light boxes.

Balsa Wood

Balsa is a Central American wood which is white, very soft, and of low density, though quite variable in its weight. Untreated pieces may weigh as little as ½ pound per board foot and from that on up to 2 pounds or more. It deteriorates rapidly after being cut, particularly in the wet season, unless specially treated. The treatment is given after the wood arrives in this country and prevents access of moisture to the fibres of the wood structure. It adds somewhat to the weight of the wood but the commercial product unless given an extra heavy treatment should not run over one pound per board foot. The owners of the encysting process figure their commercial product as weighing only about 10 pounds per cubic foot.

Balsa wood is approved by the U. S. Steamboat Inspection Service as the bouyancy element in life preservers and life rafts. On account of its light weight and good insulating properties it is also of value for cold storage insulation; and in some cases the total cost of the insulating work may be expected to compare favorably with cork blocks. Some shipboard refrigeration insulation installations of considerable size have been made during the past two or three years and at least one has been in successful operation for about six years. It will be of interest to learn how the life of this form of insulation compares with that when cork blocks are used. None of the installations as far as known to the writer has been in locations where surfaces with any considerable curvature had to be dealt with.

Beech

This wood is of interest mainly to New England shipbuilders for framing timbers and ranks with birch and hard maple. It weighs when seasoned about 44 pounds per cubic foot. The Forest Service does not consider that either Beech or Hard Maple has the lasting qualities of Birch for such parts of the construction as deadwoods, keelsons and framing about the upper part of the bilge. None of them can be recommended for the top timbers of frames.

Birch

The birch woods used for structural shipbuilding purposes are Yellow and Sweet or Black Birch. The physical and mechanical properties of the two are quite similar. They are of interest mainly to New England shipbuilders, and have been considered above in connection with Beech. Seasoned Yellow Birch weighs about 44 pounds per cubic foot, and Black Birch about 45 pounds. The latter is preferred to the former by some of the classification societies for keels, garboard and bottom planking and floor timbers.

Black Butt

This is an Australian wood and frequently reaches the West Coast markets under the name of "Iron Bark." It is used for the services referred to under Iron Bark and has given a good account of itself when used for rudder stocks of large wood vessels. It is somewhat inferior to and of shorter life than Iron Bark.

Brush Box

This is also an Australian wood and the above notes regarding Black Butt apply to it. It may be expected to have a longer life than Black Butt and very close to that of Iron Bark.

Chestnut

This is another wood of interest mainly to New England shipbuilders. Although it is a relatively long lived framing timber as regards decay, it is not as durable as regards wear and tear, and it does not possess the strength or holding power for fastenings of the other hardwoods nor even that of dense Southern Yellow Pine. It is apt to be wormy It weighs when seasoned about 30 pounds per cubic foot. It is not favored by the classification societies although its use may be approved in some locations with proper increase in scantlings (dimensions) over the more desirable woods. If some means of checking the blight are not discovered and used, this wood will soon be as extinct in this country as the dodo.

Cuban Pine

Cuban Pine or Slash Pine is a species of Yellow Pine found in the Coast regions from southern South Carolina to Louisiana. It resembles Longleaf Pine in being dense and hard, and weighs when seasoned about 45 pounds per cubic foot. It usually has more sapwood than Longleaf Pine.

Cypress

The only cypress wood of value for structural shipbuilding purposes is Southern or Bald Cypress. It weighs when seasoned about 30 pounds per cubic foot. The heart wood is exceptionally durable. Being found only in the South Atlantic and Gulf States, the structural timbers are of interest mainly to shipbuilders in those States. It contains a great deal of moisture, as has been previously noted and

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should not be built into the structure of a vessel until thoroughly seasoned.

Cypress is a swamp or lowland tree and the wood varies greatly in color; also in weight. The gulf coast cypress is usually redder in color than that grown farther north. Along the gulf coast the wood is generally called Red Cypress, farther north, Yellow Cypress, and that from the extreme northern range is sometimes called White Cypress. The "red cypress" is frequently claimed to be more durable than the "yellow cypress" and this claim has at times received classification society recognition; but the Forest Service has advised the writer that, based on the color of the heart wood, they have been unable to determine any difference in durability between red colored cypress and yellow colored cypress.

Bald Cypress for joinerwork is marketed under the name of white, yellow, red or black cypress, according to the color and weight, but these are all the one wood.

Cypress properly seasoned may be expected to receive classification society approval for such items as floor and frame timbers, aprons, deadwoods, hooks and pointers. During the recent war it received such approval for one member of a double frame, the other member being of Yellow Pine, this being more favorably considered by the classification society in question than a complete cypress frame. The writer is of the opinion that such mixed construction should not be adopted as the cypress does not react to strain and moisture conditions in the same manner as any other kind of wood alongside of it, and premature decay of the other wood may result.

Natural crook Cypress knees may also be approved but sawed knees of this material should not be used under any circumstances, as they have a marked tendency to split across.

Kiln dried Cypress is a valuable wood for interior joinerwork but it is apt to warp when used for outside sheathing and other outside work where swelling due to absorption of moisture cannot be accommodated. It is, however, frequently used for outside doors, windows, storm shutters, bucket racks, name boards, etc.

Kiln dried Cypress can also be used for calking wedges, stopwaters and plugs, but it is not as good for such service as White Pine. It can also be used as mold material.

Douglas Fir

This wood, more frequently in the east called Oregon Pine, is as has been shown, one of the two most valuable woods available to the shipbuilder in this country. It is a western wood and the strongest and heaviest wood comes from Washington and Oregon and elsewhere along the Pacific Coast. It weighs when seasoned about 34 pounds per cubic foot. The Douglas Fir from the Rocky Mountain States is inferior in strength and weighs about 30 pounds per cubic foot. The coast wood although having less strength than Southern Yellow Pine and less holding power for fastenings, is only about 13/16ths as heavy; and as considerable of the structure is interchangeable in the two woods, size for size, a wood ship built of Douglas Fir will carry more deadweight than the same ship built of Yellow Pine. Timbers of large size and long timbers and planking can be more readily obtained in Douglas Fir than Yellow Pine. In fact the timber schedules of some of the west coast wood ships would be very hard to duplicate in Yellow Pine. The wood has a tendency to check in seasoning from which Southern Yellow Pine is comparatively free.

Douglas Fir can be used for all of the woodwork in a wood ship except the rudder stock and treenails, and Douglas Fir root knees are available in large sizes and are among the best. Douglas Fir is the best decking material, all things considered, for both steel and wood ships. Old growth Douglas Fir joinerwork is serviceable, attractive and comparatively light, and for trim and built-in furniture when given a bright finish it makes a good substitute for the hardwoods that the west coast builders find it difficult to obtain.

The writer was advised by a west coast wood shipbuilder some years ago that there are three kinds of Douglas Fir timbers and lumber on the market—the red (young), the bastard (half grown), and the yellow (fully grown); that the bastard is the only kind valuable for ship timbers, the yellow having loose knots, shakes, etc.; and that the yellow is fine grained and good for joinerwork. Subsequent investigation from several sources has confirmed this. The young fir is usually of rapid growth and not sufficiently dense and the old fir is objectionable as timbers for the reasons stated. The old fir is of lighter weight, soft, easy to work and can be kiln dried with good results, while the young and bastard firs are hard and brittle when kiln dried. This variation with age in the characteristics of Douglas Fir emphasizes the value of the density rule classification previously referred to.

Elm

All varieties of this wood are tough and of long life when kept constantly wet, the Cork or Rock Elm being the heaviest, toughest, most cross grained, and best for shipbuilding purposes. Weights when seasoned run from about 35 to 44 pounds per cubic foot. The wood is of great value for the keel and keel shoe and bottom and bilge planking of wood vessels; and it has been frequently used to cover and protect from corrosion the bottoms of iron or steel vessels.

Eucalyptus

California Eucalyptus or Blue Gum is heavy, hard, tough and strong and therefore is occasionally used for the treenails or wood fastenings of wood ships. That this is not a good practice may be seen from the list of moisture content of woods previously given and from the shrinkage figures of the section of this paper dealing with treenails, which result from the relatively porous nature of the wood. The writer has been informed of one west coast ship which had to have its Eucalyptus treenails replaced by Locust before making a single trip. The wood is furthermore not very durable and checks and warps badly in seasoning. It weighs when seasoned about 54 pounds per cubic foot.

Greenheart

Greenheart is very hard and strong, and very long lived, and when seasoned weighs about 62 pounds per cubic foot. The supply comes from British Guiana. The Forest Service has found that as a beam or post it is 25 percent stronger and 50 percent stiffer than black locust, the strongest and stiffest of 130 North American woods tested by them up to 1916. It could well take the place with the east coast builders that Iron Bark takes with the west coast builders for rudder stocks of large wood vessels. It is, furthermore, highly resistant to the attacks of marine wood borers.

Gum

The gum woods grown in this country most frequently proposed for wood shipbuilding are the Black Gum and Red Gum of the Atlantic and Gulf States. They grow pretty well north and have been used to some extent by the wood shipbuilders of New England. These woods cannot be expected to have a long life except for the keel, garboard strakes and bottom planking, and as the woods are lock-grained and likely to twist out of shape in seasoning, they are of little value except for the keel and keel shoe. Their good points are that long lengths are readily obtainable, the wood is tough and has good holding power for fastenings, and iron or steel fastenings are practically incorrodible in it. Seasoned Black Gum weighs about 35 pounds per cubic foot and Red Gum about 34 pounds.

Hackmatack (see under Tamarack)

Hemlock

This wood is only of value for rough joinerwork, being light, soft, splintery and slivery. The Western Hemlock is harder and less splintery than the Eastern Hemlock. Both weigh about 28 pounds per cubic foot when seasoned.

Hickory

Hickory is very heavy and exceedingly hard and tough, the true hickory weighing in the neighborhood of 50 pounds per cubic foot. It has most of the qualities of a good treenail wood and is often proposed for such service. It is, however, too porous, allowing water to seep through it when below the waterline, and subject to considerable change in volume between wet and dry conditions when above the waterline.

Iron Bark

Iron Bark or Australian Blue Gum has been previously referred to. It is a strong, long-lived, heavy wood that is shipped to the west coast markets principally for use for rudder stocks of wood vessels. It weighs when seasoned about 70 pounds per cubic foot. It is not easy to distinguish from the Australian Gray Gum, Black Butt and Brush Box which are inferior to it. Iron Bark is also of value for fenders wearing strips and similar service for which hard White Oak is used in the east.

Lignum Vitae

This wood is also an imported wood and is the ideal wood for propeller shaft stern bearings and other bearings under water. The wear is naturally much better when on the ends of the grain than when along the grain, and the wood should be ordered in edge grain slabs or in blocks from which the desired edge grain strips can be cut without excessive waste. It is very hard and strong, and weighs about 75 pounds per cubic foot. It is of value for sheaves of blocks, rollers, fairleads, mast and flagpole trucks, etc.

Live Oak

This wood is found in the South Atlantic and Gulf States and classes as a shipbuilding timber with Greenheart and above White Oak. It is the wood of which the old U. S. Frigates were largely constructed, some of which are still afloat and more would be if not accidentally or purposely destroyed. It is compact, fine grained, very strong and durable and weighs when seasoned about 60 pounds per cubic foot. It is approved by classification societies for all parts of the structure of wood ships including the rudder stock, knees and treenails. It is not generally available at reasonable prices. It does not take spike fastenings well but there is no difficulty in fastening with bolts or treenails. Unlike other oaks in this country it is free from acid.

Loblolly Pine

This is a species of Southern Yellow Pine which is very variable in weight and strength, the light weight and rapid growth wood being of little value for structural shipbuilding purposes. It is difficult to distinguish from Longleaf Pine, but the adoption of the density rule quoted in the Grading section of this paper overcomes the difficulty and ensures the obtaining of suitable timbers. The weight when seasoned averages about 38 pounds per cubic foot.

Locust

The wood called Black Locust in some sections of the country and Yellow Locust in others, is exceedingly strong and hard and has little moisture when green and slight shrinkage from that to the seasoned condition. It weighs about 48 pounds per cubic foot when seasoned. It is mostly straight grained. These properties make it an ideal wood for the treenails of wood ships, also for dowels in scarfs, etc.

Honey Locust is sometimes proposed for treenails but this wood is lighter, brittle not so straight grained, and inferior for the purpose.

Longleaf Yellow Pine

This is the principal Atlantic and Gulf shipbuilding wood and comprises the bulk of the Southern Yellow Pine timbers supplied under the density rule of the Southern Pine Association. It is straight grained, hard and heavy, weighing when seasoned about 42 pounds per cubic foot. The leaves are from 8 inches to 11 inches long.

Like Douglas Fir, Southern Yellow Pine can be used for almost all the woodwork in a wood ship. It is somewhat handicapped for such services as decking, partition bulkhead, joinerwork and masts and booms by its weight.

Maple

The structural maple wood is Sugar Maple, called Hard Maple or Rock Maple and it is of interest mainly to New England shipbuilders for framing timbers. It weighs when seasoned about 43 pounds per cubic foot. It is difficult to cut across the grain and occasionally has a wavy or bird's eye grain. It has previously been considered in connection with Beech.

Maple makes an attractive and serviceable flooring for such rooms as the social halls of passenger steamships. It is also of value for joiner trim and portable furniture.

North Carolina Pine

This is the name given to Short Leaf Yellow Pine marketed from North Carolina and adjoining territory, mostly in the shape of joinerwork material.

Norway Pine

This wood is found in this country only in the North Atlantic and Great Lakes States. It closely resembles the lighter grades of Southern Yellow Pine, and weighs when seasoned about 34 pounds per cubic foot. It has not the strength or the life of dense Southern Yellow Pine, and when proposed for use requires increased scantlings over that wood. It is of value for masts and booms.

Oregon Pine (See under Douglas Fir)

Osage Orange

This wood is similar in weight, color, structure and other properties to Locust, and like Locust it is of value for treenails and dowels. More care has, however, to be taken to keep within the allowable limit of cross grain. It is sometimes called Bois d'Arc, being the wood from which the Indians made their bows. It is the heaviest of 130 North American woods tested by the Forest Service up to 1916, weighing when seasoned about 56 pounds per cubic foot.

Pin Oak (See under Red Oak)

Pitch Pine

This is a short leaf pine as regards its leaves, but is distinguished by a peculiarly rough, dark bark, and by the abundance of its resin. The wood resembles that of Shortleaf Pine and weighs when seasoned about 35 pounds per cubic foot. It does not take paint as well as the other yellow pines, but otherwise classes with them for shipbuilding purposes, subject to the standard grading rules.

Tar is obtained by distillation of the heartwood of this tree and pitch is the tar boiled down to the proper consistency. Hence the name of the tree. Turpentine is distilled from the sap of the tree.

Pitch Pine that has been bled during its growth is of a more uniform color than otherwise, and lighter weight. The

writer has for years considered the bled timber to be inferior to unbled timber in strength and length of life and knows a number of men familiar with handling the wood who are of the same opinion. The Forest Service, however, does not consider that the bleeding has any marked effect on either the durability or strength of the wood.

Poplar

This is not a structural wood but is valuable for high grade interior joinerwork and for furniture which is to be painted. It weighs when seasoned only about 27 pounds per cubic foot. It is easily worked, has good holding power for fastenings, takes a smooth surface and forms a good background for the highest grade of painting.

Port Orford Cedar

This wood grows in a small coast region of northern California and southern Oregon and so is of interest mainly to the shipbuilders in that section of the country. It is a very good wood for planking on small boats and on account of its durability is frequently used for the double diagonal sheathing found on some types of large wood vessels between the frames and outside planking. The wood is straight and fine grained, easily worked and a superior joiner wood both inside and outside. It weighs about 31 pounds per cubic foot. It is a good wearing wood for such service as false decking.

Red Cedar

This is a West Coast wood and is not a structural wood except for canoes, rowboats and other small craft, being too soft and lacking strength. It is a durable wood and very light, weighing only about 22 pounds per cubic foot when seasoned, but is somewhat stronger and harder than the eastern White Cedar. It is of value for joiner sheathing and panelling where light weight is essential and also as mold material.

Red Oak

This is the family name of a considerable number of oaks, as may be seen from the table, none of which is found on or convenient to the West Coast. They are very inferior to the White Oaks and of comparatively short life when used above the light waterline. They are suitable for the keel and keel shoe. Weights when seasoned run from about 40 to 50 pounds per cubic foot. Some of these, such as Water Oak, have greater strength than White Oak and are proposed as substitutes for White Oak on that account; but they are of a porous nature and do not resist decay. Like the White Oaks they are apt to check considerably in seasoning, and are usually straight grained.

Redwood

This wood, also called Sequoia, grows along the upper half of the coast of California and a small corner of Oregon; but it has been so ably advertised in the east that it appears to be used as much by the Atlantic, Gulf and Great Lakes shipbuilders as by the Pacific Coast shipbuilders. It is not a structural shipbuilding wood, being relatively soft, low in strength and splits easily. The weight varies greatly in different parts of the tree, butt logs being often very heavy; it will average, however, about 26 pounds per cubic foot when seasoned. It is of value for canvas covered decks where strength is not a factor, also for joiner trim, inside sheathing and partition bulkheads. It is not the equal of Poplar or Port Orford Cedar for these purposes and is not a good exterior joinerwork wood. It is extensively used for patterns. The wood is long lived and increases in strength with age.

Rosemary Pine

This is a grade of Loblolly Pine which departs from the characteristic wide annual rings of that species and which in the east used to be considered the ideal wood for masts. There is no stand of this wood to be found but only scattered trees, which are not apt to run over 29 inches diameter at the butt with 22 inches of heart and 14 inches diameter 76 feet up with 7 inches of heart.

Shortleaf Yellow Pine

This is another species of Southern Yellow Pine which is inferior to Longleaf Pine but superior to the general run of Loblolly Pine. Like the latter it is difficult to distinguish from Longleaf Pine, but the adoption of the density rule previously quoted overcomes this difficulty and ensures the obtaining of suitable timbers. It weighs when seasoned about 38 pounds per cubic foot. The leaves are in groups of threes, and from 3 inches to 5 inches long.

Spruce, Common

The Spruce woods of principal interest to shipbuilders are Sitka Spruce, which is a Pacific Coast wood, the White Spruce found in the region of the Great Lakes, the New England States and the Appalachian Mountains and the Red Spruce found in the two latter. The wood is straight grained and weighs when seasoned only about 26 pounds per cubic foot for the western wood and 28 pounds for the eastern wood. It is short lived, relatively weak and has a tendency to excessive shrinking and swelling with changes in weather conditions. It is not a good structural or joiner wood.

On account of its light weight and other qualities it is valuable for hold ceiling and flooring in steel vessels, hatch covers, portable wood fenders, booms and gaffs of sailing vessels, topmasts and flagpoles.

Spruce has no odor and does not taint foods. It is therefore a very desirable wood for the lining of refrigerated rooms, shelving in steward's stores, galley table tops, etc.

Spruce, Bay Shore

This is a superior wood to the above that grows along the shore of the Bay of Fundy. It is stronger, longer lived and a better structural wood in every way. It is available to the New England builders. When the timbers can be proved to be of first quality Bay Shore Spruce they are apt to receive classification society approval for all parts of the frames of wood ships, apron, deadwoods, transoms and other members.

Tamarack

This wood, which is also called Hackmatack and Eastern Larch, and called Juniper in Maine, grows in the New England, North Atlantic and Great Lakes States. It is coarse and splintery and not of general structural utility, and weighs when seasoned about 37 pounds per cubic foot. Being long lived, hard and with good holding power for fastenings, the natural crooks make excellent knees.

Teak

East India Teak is the premier shipbuilding wood, but its expense has put it out of the running for the present day main structural members or planking. It weighs when seasoned about 45 pounds per cubic foot. It is very long lived, strong, easily worked, does not crack or alter shape when once seasoned and takes a beautiful polish. These qualities warrant its use in many cases for calked decks, houses, rails, planksheers of decks and erections, deck machinery foundations, etc. It is also used for binnacles and other similar service.

Teak like Red and Black Gum has the property of preserving iron or steel fastenings embedded in it.

Water Oak (See under Red Oak)

White Cedar

Northern White Cedar, or Arborvitae, which is found in the Eastern and Great Lakes regions, is a very soft, light

weight wood, which has found some favor in the building of pleasure craft. Planking of this material will resist decay for the usual life of such vessels but it is easily scarred and the edges broken by ice or other objects with which the vessel may come in contact. The weight of the seasoned wood is about 22 pounds per cubic foot.

There is a species of White Cedar, called also Swamp Cedar or Juniper, which grows along the coast from Maine to northern Florida and thence westward to the Mississippi. It is of no value for structural purposes in shipbuilding.

White Oak

This is the family name of a number of oaks, as may be seen from the Table, all of which are good structural woods and also valuable for joinerwork finish and furniture. None of them is found on or convenient to the west coast. They weigh when seasoned from about 45 to 48 pounds per cubic foot. The wood is generally straight grained. It is apt to check considerably in seasoning. White Oak cut during the warmer months seasons more rapidly and is subject to greater checking than when cut in the winter, hence it is better to cut the wood in the winter.

All the White and Red Oaks contain gallic acid which corrodes metal fastenings and these fastenings should therefore be heavily galvanized. The acid acting on steel produces an ink which blackens the wood.

The White Oaks, except Chestnut Oak, have the large pores in the springwood densely plugged up, whereas in the Red Oaks and in Chestnut Oak these pores are more open. Hence the inferiority of the latter to the former and the decay resisting qualities of True White Oak, Burr Oak and Post Oak.

True White Oak is the most important of the group and grows in practically the entire eastern half of the United States.

White Oak is of particular value for the framing of wood ships and such special service as the rudder stock, stem and stem gripe, stern post and rudder post, keel shoe and keel, shaft log, horn timbers, fenders and wearing strips, rails and chock rails, hatch carlins and staving and bitts.

White Oak from northern Michigan or a similar locality is superior to southern white oak and should always be specified for such services as rudder stocks where particularly tough material with good torsional strength is required.

On account of the tendency of all oaks to check they should not be used in such service as house sills exposed to the weather, where the wood will usually be dry and yet is required to be watertight when there is any water about.

White Pine

There is an eastern White Pine and a western White Pine, the latter being somewhat stronger and heavier, though both are relatively soft, light weight woods, of little value for structural shipbuilding purposes. The eastern wood is a very fine joinerwork wood; but the western wood is available only in short lengths and small dimensions, and even these are hard to get in the clear grades. The eastern wood weighs about 27 pounds and the western about 29 pounds per cubic foot.

The eastern White Pine is not used as much on ships as in former years on account of its increasing scarcity and high price. It makes a good deck when not subjected to rough usage. It is the ideal material for molds.

Seasoned White Pine swells greatly when wet and this wood is therefore extensively used for wedges for calking the ceiling of wood ships, the planking of floating drydocks, etc., and such wedges are a staple article of commerce. It is also used for stopwaters in scarfs and elsewhere, for tongues to ensure the watertightness of joints in such construction as built up stern posts, and for plugs over bolt heads or where a hole is drilled for a fastening and the fastening cannot be put in.

Other Woods

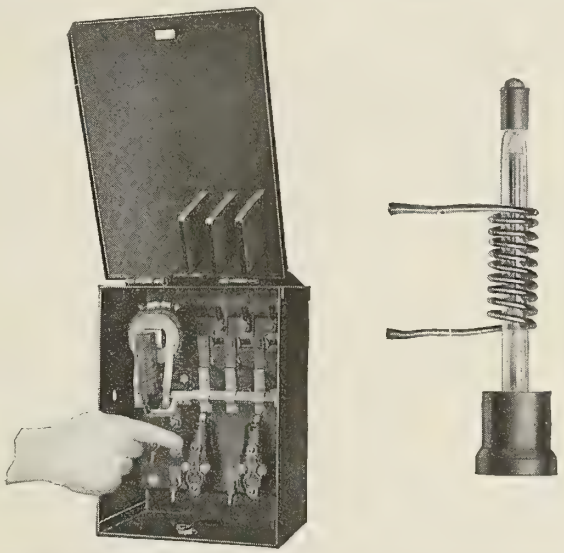
There are many other woods which find their way into ships by reason of their availability or by reason of having special artistic or other qualities that appeal to the experienced ship joiner; but their uses are in the main not peculiar to the shipbuilding field and do not merit detailed consideration here.

(To be continued.)

Automatic Starter for Squirrel Cage Motors

A NEW automatic starter for small squirrel cage motors which allows a large starting current for several seconds but at the same time gives protection against burnout troubles has been developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Two mercury overload relays mounted below the contact fingers, shown in the illustration, take the place of fuses and allow momentary overloads and overloads as high as 25 percent for a limited period without injury to the motor.

The overload relay consists of a glass tube carrying a mercury column which forms a part of the pilot circuit of the magnetic switch coil. A portion of this column is surrounded



Automatic Starter and Mercury Overload Relay

by a heating coil or thermal element. This element is in series with the motor circuit and is heated in the same proportion as the motor windings. Excessive current passing for too long a period heats the coil, causes the mercury to boil and the vapor to pass up into a chamber at the top of the tube. This action breaks the liquid mercury column and opens the circuit of the magnet coil. As this coil is de-energized, the contact fingers drop away and disconnect the motor from the line. After such an interruption, the mercury cools down, becomes liquid again, drops back into the tube so that the pilot circuit to the magnet coil is complete when the control button is depressed.

As the functioning of these overload relays depends upon the temperature at which mercury will boil, it is evident that the current required to operate the relay increases with the decrease in the temperature of the surrounding air. In other words, if the motor and the starter are installed in a cool location, the relay permits a greater starting current or a higher overload than if the temperature of the surrounding air were higher. Likewise, if the motor and starter are located in an unduly hot place, the mercury relays will act in the place of a thermo-couple.

Motorship Building in Europe

By Our Special London Correspondent

From the point of view of technical interest the four cycle engine now seems to be losing ground in Europe and the two cycle type has come much to the fore. This does not imply that more motorships equipped with the latter class of machinery are being built than are fitted with four cycle plant, but that engineers and shipbuilders are showing more actual interest as the results obtained with various designs of two stroke Diesel motors become known.

THE Doxford and Cammell Laird two stroke engines have done all that was claimed for them, the performance of the Still combined steam and oil engine appears to have been satisfactory, and just recently excellent results have been recorded from the first really important Sulzer engined motorship that has been constructed in Europe. A number of smaller craft fitted with Sulzer engines have been built but the completion at Armstrong's yard on the Tyne of the 6,500-ton motor tanker *Conde de Churruca* affords the first opportunity for engineers and shipowners to gain some idea of the suitability of the Sulzer two cycle engine for the propulsion of large ships. The trials were run at the end of August and the beginning of September, and in view of the fact that many engineers consider this type to be the best on the market, a few of the technical features which struck the writer with some force at the time of the trials may be mentioned, for there is no doubt that unusual originality has been shown by the designers of the Sulzer motor.

Each of the engines develops 1,250 brake horsepower at 100 revolutions per minute, this being equivalent to 1,750 indicated horsepower. There are four working cylinders 23⅜ inches diameter by 37 inches stroke and the ordinary scavenging pump and three stage air compressor are driven off the crank shaft. All the accessory pumps required while the ship is at sea, such as the bilge pump, circulating water pumps for piston and cooling water, lubricating oil pumps, etc., are driven off the main engine, so that no engine room auxiliary is required when the ship is under way. This is quite different from the arrangement in all Burmeister and Wain engined ships as well as in many other types where the auxiliary pumps are driven by electric motors and the main engine operates nothing but the three stage air compressor. The Sulzer arrangement is similar to that adopted in steamers and for this reason will no doubt appeal to most marine engineers of the old school.

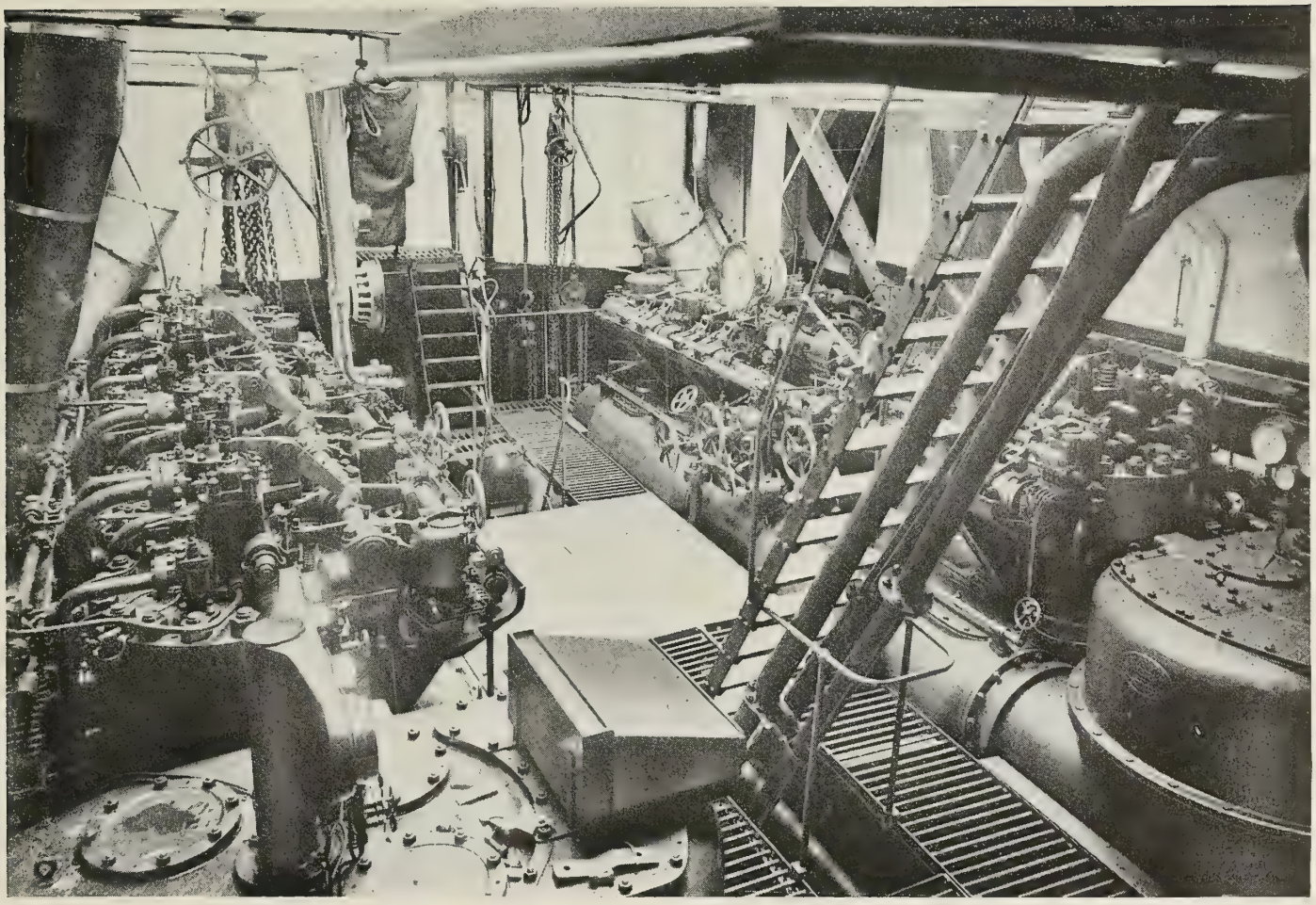
For the first time, so far as the writer is aware, it is proposed to operate the engines of this motorship on boiler fuel oil and upon the results achieved a good deal depends. If for engines of this type it can honestly be claimed that they will run on boiler furnace oil costing only about two-thirds as much as Diesel fuel commonly used in four cycle motors, it is clear that the two cycle type will find increasing favor among shipowners, more particularly as fuel oil will always be easier to obtain than Diesel oil.

Control Station on Top of the Engine

One of the novelties in the Sulzer engined ship is that the control station has been arranged right at the top of the engine, the main object being to eliminate much of the gear that is otherwise necessary. In the reversing mechanism, instead of the camshaft being moved bodily, there are the usual side by side cams but each valve lever is provided with two rollers on a forked arm, one of which can be brought in contact with the ahead cam and the other with the astern cam according to the direction of rotation required. One of the claims of this arrangement is that it also enables the reversing wheel, which carries out the operation to control the lift of the fuel valve needle when the engine is running. At low speed, therefore, not only is the amount of fuel controlled but also the lift of the valve, this being an undoubted advantage for slow running.

Chief among the claims made for the Sulzer engine is that it is immune from the possibility of cylinder covers being cracked and, as is well known, this has always been one of the great difficulties in connection with two cycle engines. The reason for this immunity is that there is only one hole bored centrally in each cylinder cover, this being for the valve cage which contains both the fuel valve and the starting air valve. As the trouble with cylinder covers has usually been put down to the number of holes bored in them, the makers' claim in this case appears to have some justification.

Motorship Conde de Churruca, Built by Armstrong Whitworth and Company



The Tops of the Two 1,250 Brake Horsepower Sulzer Engines in the Motorship Conde de Churruca, Showing the Engine Controls in an Unusual Position

Special Features of the Sulzer Engine

There are several other points in the design of the new Sulzer motors that will interest the engineer. Crosshead lubrication, one of the problems in two cycle engine design, is effected by a special pump at a pressure of 300 pounds per square inch although the lubrication of the rest of the engine is practically only by gravity. A neat device in connection with the starting air valve allows the starting air on the exhaust stroke of the piston to be delivered back into the scavenging trunk, the result of which is to relieve the pressure in the cylinder and also to charge up the scavenging air, so that, when the engine starts firing, there is already a pressure in the scavenging trunk.

Trouble with air compressor valves appears to have been overcome by a new design, with which they are set in a conical cage, that can be taken out bodily by unscrewing two or three bolts. Instead of having piston valves in the scavenging pump, these are of the disk type and the air is not drawn into the scavenging cylinder direct from the engine room but passes through the large wooden chamber, several feet cube, perforated by holes. An excellent silencing effect is obtained and the exhaust is also comparatively silent.

Comparative Fuel Consumptions of Diesel Engines

From these brief details it will be seen that the *Conde de Churruca* is a ship of exceptional interest and in the writer's opinion no point is of more importance than that of the possibility of running the engines on boiler furnace oil. Success in this direction may have more far reaching results than appear likely on the surface.

There is a surprising similarity between the fuel consumptions of various types of marine Diesel engine now being built as the following figures will show. These are based upon actual test results and apart from the Still and Cammell Laird engines it will be seen that there is little to choose from them and the difference between two cycle and four cycle consumptions is not so great as had been thought. The Cammell Laird engine certainly appears to give excellent results but it should be added that this test, which is the only one which has been carried out, was for a period of only 12 hours and it may be that circumstances were especially favorable. At any rate it seems difficult to understand why this type of motor should have a higher efficiency than the four cycle engine. The Still combined steam and oil engine has been subjected to very long tests at Scott's works and the figure quoted appears to have been definitely established as correct.

The results obtained are as follows:

Type of engine	Pounds per b.h.p.hr.
Burmeister and Wain (four cycle)	0.40
Vickers (four cycle solid injection)	0.42
North British (four cycle)	0.42
Sulzer (two cycle)	0.42
Doxford (opposed piston)	0.43
Cammell Laird (opposed piston)	0.39
Still (combined steam and oil)	0.36

Motorship Building Activity

In spite of the very unsatisfactory position of the shipbuilding industry in Europe there is quite a large amount of activity in connection with motorships. During the past few weeks a new 14,000-ton cargo vessel has been launched for the Royal Mail Steam Packet Company at John Brown's

yard on the Clyde, the first motorship for shipowners and shipbuilders, while the *Haurak,* a 11,000-ton cargo vessel for the New Zealand trade, was launched at Dennys' for the Union Steamship Company.

Norwegian Motorships

The largest vessel ever built in Norway, the *Handicap,* has just been put in the water at Stavanger. She is a 9,000-ton ship to be equipped with 2,700 brake horsepower Sulzer engines and further activities in Norway include the completion of the Bergen Steamship Company's first motorship and the placing of a new order by Fred Olsen for a 7,000-ton cargo boat.

The Rotterdamsche Lloyd has just acquired a motorship completed at Burmeister and Wain's yard and will take delivery in October, while in the same month the first motor passenger ship ever built, the *Domala,* belonging to the British India Steam Navigation Company, will run her trials.

With the remarkable reduction in the cost of steel, the settlement of the joiners' strike and the reduced shipyard wages, shipbuilders are hoping that, soon, orders for new tonnage and especially for motorships will become more plentiful.

Full Diesel Engine of New Design

A FULL Diesel four-cycle engine, recently produced by the Lombard Governor Company, Ashland, Mass., embodies special features of cylinder construction which permit easy access to all moving parts, and the ready removal of the piston and shaft whenever necessary. The engines are of the heavy duty type built in two-cylinder sizes 9½ inches by 13½ inches, and 13 inches by 19½ inches, and in multi-cylinder combinations of 2, 3, 4, 6 and 8, giving a range of from 60 to 500 brake horsepower.

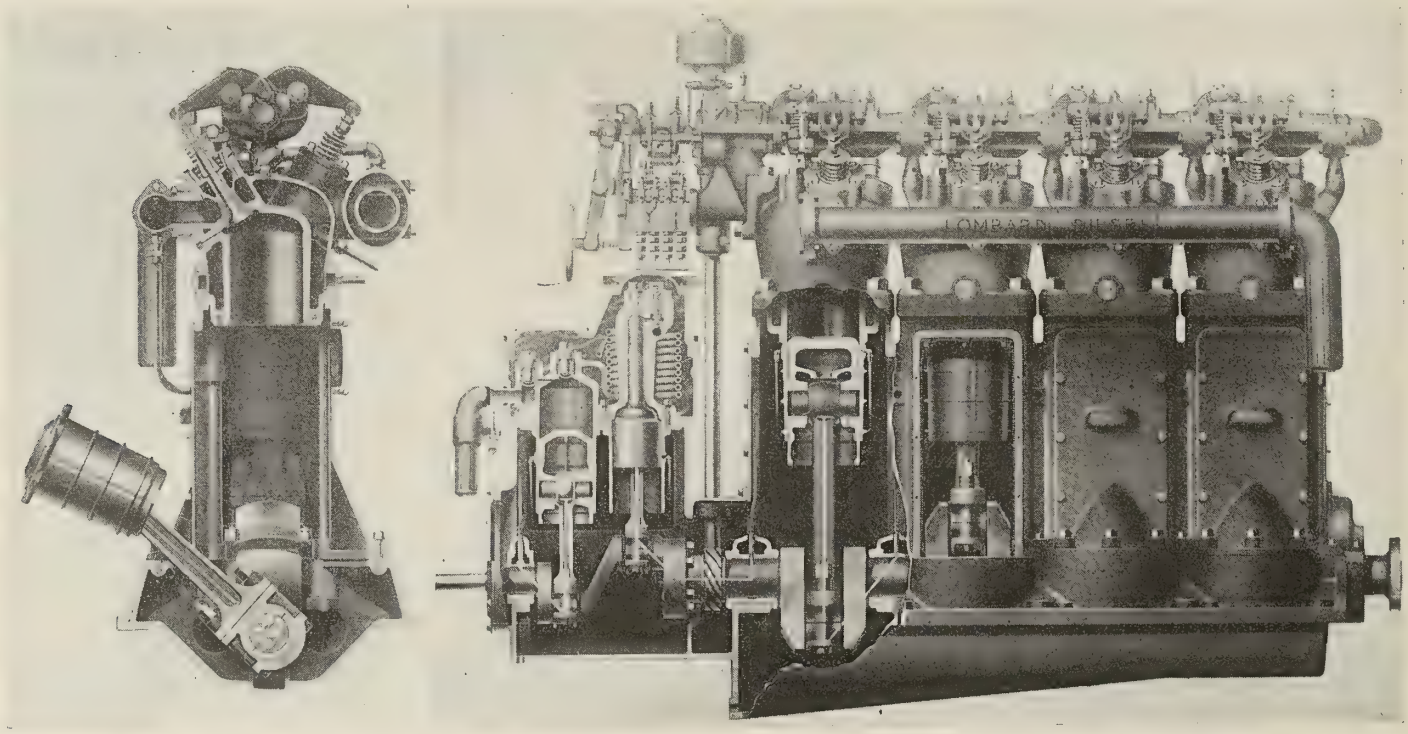
The cylinders are mounted in a large waterbox and are designed with removable skirt sections bolted to the bottom. With the crank on the bottom center, and the skirt detached from the cylinder casting, any piston with its connecting rod can be swung forward through the crank case door opening without removing the cylinder head, disconnecting the crank pin box, dismounting the valve gear or otherwise disturbing adjustments which it is desirable to preserve.

Oil is fed to the engine under pressure, which ensures thorough lubrication to all parts. The lubrication system includes filters and coolers so that the oil may be used repeatedly.

The air compressor is a balanced duplex design with cranks at 180 degrees.

Engine Framing

The frame sections which inclose the crank case are arranged to support the weight of the engine, while four heavy steel tie rods which extend from each cylinder to the main bearing pads within the bedplate carry the working load and relieve the frame from all tensile stresses. The removal of frame housing doors and tie rods along the front or air intake side permits rolling the main crank shaft out in the space directly alongside of the engine without dismounting the cylinders or disturbing the valve gear. All valves on the engine open outward and are readily accessible.



Sectional Views of Lombard Engine, Showing Accessibility of Reciprocating Parts Through Front Crank Case Door Openings

Developments in Marine Insurance

(*Concluded from page 732.*)

treal is located five hundred miles from the ocean on a river subject to heavy fogs involving strandings and collisions, and, furthermore, vessels having arrived at the mouth of the St. Lawrence must encounter the perils of ice and fog off the Newfoundland coast before reaching the safer regions of the Atlantic. It is estimated that it would cost $252,728,000 to construct the proposed all-water route. Undoubtedly it would mean much for Canada, but Montreal would always suffer by comparison with New York, from the standpoint of an available port, because it has to be closed from December 1 to the middle of April; which means the likelihood of inefficiency in a labor population that must be deprived of shipping activity for five months of the year.

General Cargo Transferring Speed Per Linear Foot

Material Handling Devices and Ample Space Prevent Delays; Wharfboats Utilized in Some Places

AS derived from a study of the records of many inland and ocean port terminals, extending over many years, it was found that there were transferred, where mechanical or other modern facilities had not been installed, about 125 to 150 tons per lineal foot per year. Where cranes and other machinery and co-ordinating railway tracks were provided, this 150 tons per foot was increased to 450 to 500 tons per foot annually.

Since these figures were recorded, due to still better facilities, whereby the flow in and out of freight in the sheds and on the open quay has been made more constant and uniform by machinery supplementing the cranes, these ton foot figures have been increased.

These were the average figures of the cargoes for all the port quay and pier frontages for all the year, and not the results of special tests. Part of the time there were no vessels berthing and at other times vessels two deep were waiting to obtain a place alongside the quay or pier wall. The totals being derived from many separate and diverse locations give a fair average for estimates. These figures were derived from average commercial ports and not from those where there might have been special difficulties or where there was a great rise of water, very high banks or other delay producing conditions. The rail coordinating tracks were only a few feet above the water level and the direct transferring between water and rail caused little loss of time.

For each six hundred feet, lifting directly by cranes from vessel to shore and the reverse movement, were transferred from 90,000 tons without improvements, to 300,000 tons per year with improvements. The port of New York being deficient in mechanical facilities has averaged about 150 tons per linear foot, and during past years the above average has been true of San Francisco.

Excess Lineal Frontage Needed

It is estimated that a prosperous terminal of the large cities should have facilities provided for at least 1,000,000 tons per year. In order not to delay the barges or other vessels there must be an excess lineal frontage as at certain periods there will be a large number of vessels to discharge or receive cargoes, and these must not be delayed. Improved and ample facilities are provided to prevent such delays of the vessels.

From the above figures, however, it can be determined what the total frontage must be including the excess to provide for the usual conditions of arrivals of vessels.

At 150 tons per linear foot for 500,000 to 1,000,000 tons minimum there would be required from 3,500 to 7,000 linear feet, at 500 tons per linear foot there would be required from 1,000 to 2,000 linear feet.

Where there are quick-acting cranes, one every 62½ feet, as at Hamburg, transferring directly from the top of the quay, or shed, into the vessel by one movement and no rehandling, even though the bank may be sixty feet or even more in height, there can be attained 500 tons per linear foot. The length of the ropes in hoisting is no more than into or from ocean general cargo vessels along the Atlantic Coast where the distance from the bottom of the hold to the top of crane jib is fully equal to as much as the 60 foot banks, and the figure of 500 tons was largely derived such cargo-ship transferences.

If, however, there are to be delays in the movements in and out, that is, congestion points due to limited assorting and distributing areas, then there would be required at least 4,000 feet, which includes the excess which experience has found necessary. For outbound freight, due to the advent of the motor dray which must come near the outbound vessel, more space than formerly must be provided.

Wharfboats

In some places, as per the above photograph more wharfboats are being provided. Without criticism, but applying the above rules, there are deduced the following facts:

These wharfboats are only 230 feet long, 75 feet wide and 21 feet in depth. For a standard terminal they appear too short, too narrow and it seems as though there must be congestion. The center of the boat is occupied with three

Wharfboat

railway tracks with narrow platforms on each side. These railway tracks are connected by means of aprons and floating bridges to the other tracks on the shore. As the variation in the height of the rivers may be fifty feet or more, varying according to the flood stages, there are times when the transfer speed will be greatly reduced.

The cargo handling equipment consists of four electrically driven telphers, each having a lifting capacity of two tons at 150 feet per minute, and a traveling speed of 300 feet per minute with an outreach of 40 feet over the offshore side of the wharfboat.

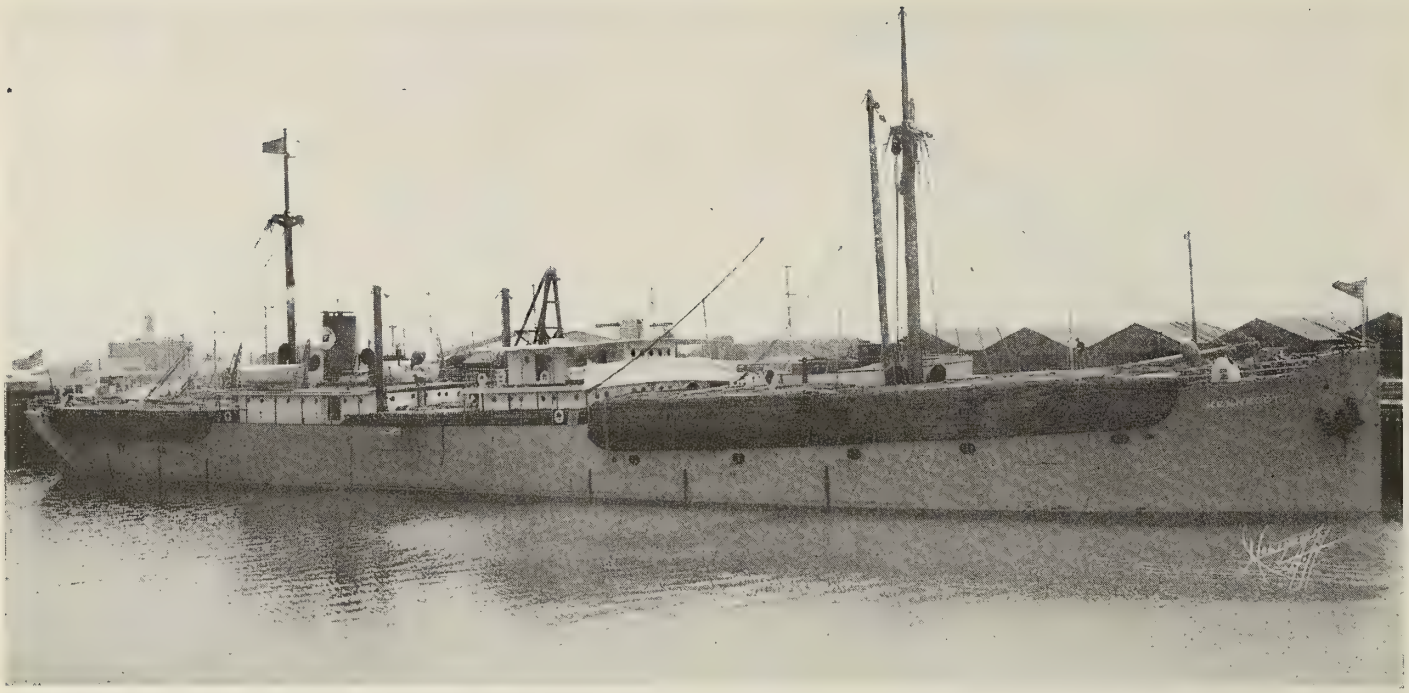
To transfer 1,000,000 tons of freight per year by means of wharfboats there would be required about 15 such wharfboats, providing for delays, congestion and unoccupied berths.

The probable cost of these wharfboats, aprons, bridges, accessories and shore works with connections would probably be not less than $5,000,000.

With the quick-acting cranes giving direct transference from car to barge the cost for all appliances with equivalent results would probably be less than one-fourth, the vessel detention about one-third, and the operating costs, including interest and maintenance should not exceed one-fourth.

If the tonnage be less, the above proportions would be about the same.

It seems as though there would be considerable congestion due to constricted areas on the wharfboat.



Motorship Kennecott, of 6,500 Tons Deadweight Capacity, Built at Tacoma Plant of Todd Shipyards Corporation and Engined with Two 1,200 Indicated Horsepower McIntosh & Seymour Diesel Engines

Performance of the Motorship Kennecott

Largest American-Built Motorship Covers 15,000 Miles in Six Months With No Expenditures for Repairs

By Frank Walker*

CONSIDERABLE interest has been aroused by the remarkable performance of the new 6,500 deadweight ton steel twin screw motorship *Kennecott,* built by the Tacoma, Washington, plant of the Todd Dry Dock and Construction Corporation for the Alaska Steamship Company, whose headquarters are in Seattle and from which port they have for many years operated a fleet of steamships.

This vessel is built under special survey of the American Bureau of Shipping, being granted Class A-1. Her general dimensions are: Length, 360 feet overall; beam, 49 feet, 6 inches; load draft, 22 feet.

The main propelling machinery consists of a twin installation of 1,200 horsepower six cylinder reversible four cycle full Diesel marine oil engines built by the McIntosh & Seymour Corporation, Auburn, N. Y., and driving twin propellers at a maximum speed of 140 revolutions. Photographs of these engines were published on page 633 of the August, 1921, issue of MARINE ENGINEERING.

AUXILIARIES ELECTRICALLY-DRIVEN

All auxiliaries both deck and engine room are driven by electricity, energy for this purpose being supplied by two 75 kilowatt General Electric generators, each coupled with a two cylinder 100 horsepower McIntosh & Seymour full Diesel engine. Each of these auxiliary engines is fitted with an air compressor, the discharges of which are connected to a compressed air main which is used to fill the air bottles or to supply the injection air. By this means air for starting the main engines is obtained in a few minutes after either of the auxiliary engines is started.

The *Kennecott* was launched at Tacoma on January 6, 1921, after which the machinery was installed and on March 17 a trial trip was run on Puget Sound. During the trials, which were made with the vessel light and included exhaustive maneuvering tests, a speed of 12.8 knots was easily maintained, although the specified contract speed was 11 knots.

MAIDEN VOYAGE SHOWS FUEL ECONOMY

Upon being delivered to her owners the *Kennecott* was loaded with lumber, taking 3,500,000 feet, and on her maiden voyage made the run from Bellingham, Wash., to San Pedro, Cal., in four days and five hours. During this voyage she used exclusively the same fuel oil as is burned under the boilers of the company's steamers. Before injection, however, this oil is heated by means of coils contained in a specially designed exhaust silencer. After heating, the oil passes to the day tanks for consumption.

On her first day's run she logged a distance of 292 nautical miles, averaging a speed of slightly over 12 knots. The consumption of oil was 65 barrels, 16 degrees Baumé, the cost of this fuel being $1.78 per barrel—decidedly a low fuel consumption per ton mile. This day's run, however, was in calm weather; on the second day out the vessel averaged approximately 10.5 knots against a strong head wind and sea, consuming the same amount of oil.

After discharging her cargo at San Pedro she returned light to San Francisco, making the run of 335 miles in 1 day 6 hours and 45 minutes. Here approximately 700 tons of freight was loaded and she then proceeded to Seattle via Victoria, B. C., covering the 742 nautical miles in 2 days 16 hours, averaging 11.5 knots.

(*Concluded on page* 782.)

*Marine surveyor, consulting engineer and naval architect, Seattle, Wash.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department

Conducted by James L. Bates

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Propelling Machinery Design Problem

Q. (1137).—It is proposed to make a change in the steam propelling plant on a twin screw vessel, fitted with two small watertube boilers with a working pressure of 200 pounds per square inch, two triple expansion engines with cylinders 8 inches, 13 inches and 21 inches in diameter and 16 inches stroke, each of approximately 140 horsepower. What would be the size of two compound engines (diameter of cylinders for 16-inch stroke) to replace the above engines to operate the vessel at a speed of 8 knots, using a steam pressure of about 150 to 160 pounds per square inch in a single Scotch boiler? Also what would be the size of the boiler (diameter, length and horsepower)? Please show method of computation for above engines and boiler. Also please suggest some reliable text-books giving computations of this kind.

A. (1137).—The specific information as to sizes, power, etc., could be given only after a thorough investigation of the subject, based upon a full knowledge of all the factors involved. Such an investigation, while not considered practicable for these columns would, if undertaken, be in outline about as follows:

(a) A study of the form and resistance of the hull and appendages and the derivation of curves of effective horsepower therefor.

(b) A study of the conditions under which the propellers are to work and the fixing of the principal characteristics for the propellers.

(c) The fixing of the principal features of boilers and engines.

Form, Resistance and Power

There are so many different factors which enter into the resistance of the ship's hull that no simple formula can be expected to give very close results for vessels of different types at varying displacements and drafts. Mr. E. M. Bragg, in the section on Ship Forms and Power in the "Marine Engineer's Hand Book" by Sterling, page 1025, gives a formula which he states is fairly satisfactory in practice. This formula is

$$I.H.P. = (D \times V^3) \div C\sqrt{L}$$

D is the displacement in long tons.
V is the speed in knots.
L is the length between perpendiculars and
C is a factor, information relative to the value of which is also given.

The best method of estimating effective horsepower known to the writer is that described by Admiral D. W. Taylor in "Speed and Power of Ships." This method takes into consideration the effect upon resistance of the principal dimensions of the vessel and their relations one to another as well as that of the prismatic or longitudinal and midship section coefficient. It furnishes a means of deriving a very accurate curve of effective horsepower covering the entire speed range contemplated provided the form of the vessel in hand is closely similar to that of the model upon which Taylor's data are based. A careful study of the entire book is necessary in order to obtain a proper appreciation of the subject. For those portions most vital to the actual derivation of the power curves, see Figs. 41, 78 and 81 to 120 inclusive, also table X, all in Volume II, Tables and Plates.

Certain classes of vessel do not usually fall within the limits covered by Taylor's investigation. Among these are full cargo carriers, tugs, etc. A method applicable to such types is described in the "Marine Engineer's Hand Book" by Sterling, pages 1013 to 1027 inclusive.

The effective horsepower, as above described, is for the bare hull; that is, it does not provide for the resistance of appendages, such as bilge and docking keels, rudders, propeller shafting, struts, etc. Therefore, the effective horsepower, bare hull, must be increased by a percentage to allow for the appendage effect. For the values between which this percentage varies, depending upon the character of the appendages, see "Screw Propellers for Hydraulic and Aerial Propulsion" by Admiral Dyson, pages 26 to 30.

The Propeller

Admiral C. W. Dyson, in "Screw Propellers for Hydraulic and Aerial Propulsion," discusses the problem of propeller design in detail. A condensed discussion of this subject by the same author may be found in pages 1028 to 1076, "Marine Engineer's Hand Book" by Sterling, previously referred to. The characteristics of the propellers selected must be such as to develop the required thrust at the designed speed while working behind the hull contemplated, all at a reasonable efficiency.

Boilers and Engines

An up-to-date discussion of the principles underlying engine and boiler design may be found in "Marine Engineer's Hand Book," pages 821 to 837, relating to the development and determination of size of engines and pages 837 to 877 relating to the proportioning of engine parts. Pages 877 to 918 relate to valve gear pumps, piping and fittings.

The fixing of the type and size of engines and auxiliaries will make possible an estimate of the steam which the boilers must furnish. Pages 343 to 358, "Marine Engineer's Hand Book," cover the subject of general boiler design, while pages 359 to 375 give data relative to dimensions and weights for certain commercial types of boiler.

Taylor's "Speed and Power of Ships" is published by John Wiley & Sons, Inc., New York City, as is also Admiral C. W. Dyson's "Screw Propellers for Hydraulic and Aerial Propulsion." Sterling's "Marine Engineer's Hand Book" is published by the McGraw-Hill Book Company, Inc., New York City.

Metacentric Height of Hopper Barge

Q. (1134).—A hopper barge of box form is 200 feet long and 40 feet broad, the hopper being the amidships portion 50 feet long. When the hopper is empty the draft is 10 feet and the center of gravity is 15 feet above the keel. What is the metacentric height (1) when the hopper is empty, (2) when the discharge portion is open, (3) when the hopper is filled to a height of 10 feet with mud of specific gravity of 2.

A. (1134).—From the wording of your question, it is possible to assume that the hopper space occupies the entire midship portion of the barge. As it materially simplifies the actual work of finding the draft, metacentric height, etc., in certain conditions, this assumption has been made. It has also been assumed that all water is salt of 35 cubic feet per ton, that the mud in part (3) is $\frac{35}{2}$ or 17.5 cubic feet per ton and that no allowance for structure is necessary.

PART (1) HOPPER EMPTY

$$\text{Metacenter above base} = \text{V. C. B.} + \text{B. M.} = \tfrac{1}{2}\text{ draft} + \frac{\text{Inertia water plane}}{\text{Volume of displacement}} =$$

$$5 + \frac{(40)^3 \times 200}{12 \times 200 \times 40 \times 10} = 5 + \frac{40 \times 40}{12 \times 10} = 18.33 \text{ feet}$$

Height of center of gravity as given..... 15.00 "

Resulting value of metacentric height..... 3.33 "

PART (2) DISCHARGE PORTS OPEN

In this case the water in the hopper will rise till it stands at the same level as that outside.

Let X = depth of water above bottom in hopper
Y = increase in draft of barge due to opening of hopper to sea
Then $50 \times 40 \times X = 200 \times 40 \times Y$
also $X = Y + 10$
whence $Y = 3.33$ and X = new draft = 13.33 feet.

There are now two methods of solution possible. (a) The "Lost Buoyancy." (b) The "Added Weight." For a detailed discussion of the principles involved, see any standard work on theoretical naval architecture. The results when expressed as the moment of statical stability are the same for each method though the metacentric height differs in inverse proportion to the displacement resulting.

LOST BUOYANCY

$$M = 6.667 + \frac{(40)^3 \times 200 - (40)^3 \times 50}{12 \times 150 \times 40 \times 13.33} = 16.667 \text{ feet.}$$

This method assumes that the original buoyancy of the hopper space is lost without other effect on the ship; hence the position of the center of gravity is unchanged and the metacentric height is 1.667 feet. Moment of statical stability = *2285 x 1.667 = 3809 foot tons.

ADDED WEIGHT

$$M = 6.667 + \frac{(40)^3 \times 200}{12 \times 200 \times 40 \times 13.33} = 16.667$$

Virtual center of gravity of added water =

$$6.667 + \frac{(40)^3 \times 50}{12 \times 50 \times 40 \times 13.33} = 16.667$$

Barge empty $2285 \times 15 = 34275$
Water admitted $761.7 \times 16.667 = 12695$

3046.2 15.417 46970

Value of G. M. = 16.667 — 15.417 = 1.250
Statical moment of stability = 3046.2 x 1.25 = 3809.

PART (3) HOPPER FILLED TO HEIGHT OF 10 FEET WITH MUD

Weight added to displacement as in part 1 = $\frac{50 \times 40 \times 10}{17.5} = 1142$ tons

New displacement = 2285 + 1142 = 3427 tons.

New draft = $\frac{3427}{19 \times 12} = 15.04$ feet.

Mud of the density specified probably will not be a solid mass nor will it flow as easily as water. Hence its effect upon the stability of the barge will not be exactly that as calculated upon either the assumption of solidity or of full free surface but will be somewhere between the two.

Figured as a solid we have

$2285 \times 15 = 34250$
$1142 \times 10 = 11420$

3427 13.33 45670

$$M = 7.52 + \frac{(40)^3 \times 200}{12 \times 40 \times 200 \times 15.04} = 16.39$$

Value of G. M. = 16.39 — 13.33 = 3.06 feet.

*Weight of barge.

Figured as a liquid with full free surface we have M for mud in hopper =

$$5 + \frac{(40)^3 \times 50}{12 \times 40 \times 50 \times 10} = 18.33$$

Then by added weight method

$2285 \times 15 = 34275$
$1142 \times 18.33 = 20940$

3427 16.1 55215

Value of G. M. = 16.39 — 16.1 = .29 feet.

When the barge is subjected to the action of waves, the motion of the mud might be sufficiently sluggish so that its effect on the motion of the barge would be less serious than a more easily flowing liquid.

If, on the other hand, the barge were in quiet water and were given a slight initial list, the mud would eventually take practically as great a transverse shift as a lighter liquid.

Motorship Kennecott

(*Concluded from page* 780.)

RECORD RUN TO NEW YORK

On her second voyage from Seattle, Wash., to New York she loaded 3,000,000 feet of lumber and 1,200 tons of copper ingots on Puget Sound, and then proceeded to Aberdeen, Grays Harbor, where another consignment of lumber was taken aboard. She left Aberdeen on May 6 and arrived at Panama on May 20, a distance of 3,960 miles, and arrived at New York on May 29, a total distance of 5,994 nautical miles in 23 days and 7 hours. On this run the engines were operated at from 126 to 130 revolutions per minute. Unfortunately, however, an absolutely accurate account of oil consumption was not kept, but as nearly as possible in checking the contents of the fuel tanks the daily consumption is calculated as 60 barrels, or 8½ tons.

During the time of loading in Seattle a careful check of oil consumption of the auxiliaries was kept and it was found that it took only 31 barrels of oil to load the 3,000,000 feet of lumber. Further perusal of the log discloses the fact that with all four cargo hatches and all eight winches working, the fuel consumption, including the electric light, standby pumps and all other equipment, amounts to only four barrels per 24 hours, a charge which, it is claimed, cannot be equalled by the most efficient steamship in operation.

Upon the vessel's return voyage from New York to Seattle a general cargo was loaded of approximately 3,500 tons and during the entire trip an average of 10.9 knots was maintained on a daily consumption of 60.5 barrels of low grade fuel and average port consumption of 2.3 barrels. It is interesting to note that the average engine room temperature for the round voyage was 85 degrees, the variation above and below this temperature being never more than a few degrees Fahrenheit.

The engines were operated at an average of 129 revolutions per minute from New York to Colon, and 131 from Balboa to Seattle.

RELIABILITY PROVED

Nothing further need be said as to the reliability of her machinery, as in the actual words of the owners they are "more reliable than steam," having been in constant operation for six months and covering approximately 15,000 miles without one cent being expended for repairs.

Considerable credit is due the Todd Dry Dock and Construction Corporation in the design and construction of the *Kennecott*, as never before has this concern built or had any actual experience in the construction of full Diesel motorships. To turn out, without previous experiment, so successful and consistent a vessel speaks well of the engineering ability to be found in our western shipyards.

PERSONAL MENTION

Thomas H. Rossbottom, vice-president and general manager of the Panama Railroad and Panama Steamship Company, has been appointed general manager of the United States Lines, 45 Broadway, New York. He has taken up active duty in his new quarters and will continue to devote a few hours each day to the business of the Panama Company. Mr. Rossbottom was born in New York City in 1874 and received his early training in the public schools, business colleges and evening commercial schools. He first went with the Panama Railroad Company in 1887 and is widely known in railroad and steamship circles as an expert traffic manager, having been advanced by various stages through the departments of traffic, cashier, operating, both land and marine. When the Columbian Steamship Line was taken over in 1893 by the Panama Company, Mr. Rossbottom became active in ship operation, being advanced until he had become third vice-president in charge of operation of the Panama Railroad and Steamship Line. It is believed his appointment to managing affairs of the United States Lines is temporary in order that the clearing up of the transportation situation may have the benefit of his expert knowledge and training.

T. H. Rossbottom

David W. Niven has been appointed manager of the marine sales of the General Electric Company. In his new position Mr. Niven will direct sales to the Federal Government for naval and other purposes. Mr. Niven has been with the General Electric Company for twenty-one years and in the marine department since 1910. He is a native of Scotland and before coming to this country was identified with the Siemens Brothers in London.

D. W. Niven

M. F. Cropley, formerly assistant manager of the Admiral Line, has been appointed manager of this line for the Oregon district. Mr. Cropley is one of the best known steamship men on the Pacific Coast. Starting years ago as cashier on the docks of the Alaska Navigation Company, he was soon promoted to the office of general agent. When the Alaska Navigation Company and the Pacific Coast Steamship Company were consolidated as the Admiral Line, Mr. Cropley was appointed general freight agent, later he was promoted to the position of passenger and traffic manager at Los Angeles and subsequently held the same position in Portland, Ore. In April, 1920, he was made assistant manager of the line.

George W. Barr, son of John W. Barr, a director of Vickers, Ltd., Barrow-in-Furness, England, has been appointed general manager of the shipbuilding department of Vickers, Ltd., vice Robert Pollock resigned. Mr. Barr left Barrow ten years ago to become shipyard manager of the Australian Dockyard, Sidney, Australia, and subsequently became outside manager for Beardmore, Ltd., Dalmuir, Scotland.

E. S. Gregg, of the American International Corporation, New York, has been appointed by Secretary of Commerce Hoover to head the new transportation division of the Bureau of Foreign and Domestic Commerce. During the war Mr. Gregg was a member of the shipping section of the general staff of the War Department. Since leaving the War Department he has been adviser on shipping to the American International Corporation.

David B. Carson, of Nashville, Tenn., for many years general manager of the Nashville, Chattanooga and St. Louis railroad, has been appointed Chief of the Bureau of Navigation, Department of Commerce, to succeed Eugene T. Chamberlain, who has been in charge of this Bureau for more than twenty-seven years. Mr. Carson assumed his duties as Acting Commissioner of Navigation on August 27, pending confirmation of his appointment by the Senate. Mr. Carson is not only an experienced railway man but has also had extensive experience in matters pertaining to marine transportation, through supervision of river and transfer steamers for the Nashville, Chattanooga and St. Louis railroad. Mr. Chamberlain, the former Commissioner of Navigation, who has been made assistant to the chief of the transportation division of the Bureau of Foreign and Domestic Commerce, was appointed Commissioner of Navigation by President Cleveland in 1893 and served through the Republican and Democratic administrations of Cleveland, McKinley, Roosevelt, Taft and Wilson.

David B. Carson

Thomas A. Graham, formerly assistant freight traffic manager of the Southern Pacific Company, has been appointed general manager of the Pacific Mail Steamship Company, vice John H. Rosseter resigned. Born in San Francisco in 1864, Mr. Graham was not quite fourteen years old when he took his first job as an office boy for the North Pacific Coast Railroad, a line operating between San Quentin and Duncan's Mills, Cal., which is now a part of the Northwestern Pacific system. Transferring to the Southern Pacific Company in December, 1881, Mr. Graham was at first a clerk and then chief rate clerk in the San Francisco general passenger office until December, 1889, when he became district passenger and freight agent at Tacoma and Seattle. After ten years he was made district freight and passenger agent at San Jose, Cal., serving in that capacity until 1901 when he became assistant general freight agent at San Francisco. Four years later he went to Los Angeles as assistant general freight and passenger agent, coming back to San Francisco in 1911 as general freight agent. A year later he was made assistant freight traffic manager, retaining this position until his present change to the Pacific Mail Steamship Company.

J. P. Sutherland has been appointed head of the passenger branch of the traffic department of the United States Shipping Board.

Samuel Magrill has been appointed general freight agent of the Black Diamond Steamship Corporation, vice Paul D. Kaufmann, resigned.

Capt. E. L. McNoble has been appointed superintendent of terminals for the Admiral Line at Seattle. He has been acting as port captain.

W. E. Decker has been appointed purchasing agent of the Port Arthur Shipbuilding Company, Port Arthur, Ontario, succeeding N. S. Thrasher, who died recently.

Wilmer M. Wood, formerly on the staff of the Kerr Steamship Company, has been appointed general freight agent of the United American Lines' intercoastal service.

George W. Sterling, formerly director of operations of the Shipping Board for the New York district, is now associated with the Export Steamship Corporation, New York.

H. A. Duffy, formerly chartering executive of the Shipping Board, is now connected with the Equity Steamship Company, 11 Broadway, New York, covering the general chartering market.

Morris Malkin, of New York, who during the war was secretary of the Chartering Committee of the Shipping Board at New York, has been appointed manager of the Shipping Board chartering department in New York.

Joseph A. Robinson, of Armstrong, Loeser & Robinson, steamship agents and ship brokers, of New York, has been appointed an assistant on the staff of J. Barstow Smull, vice-president in the operating division of the United States Shipping Board.

R. L. Francis, formerly freight traffic manager in charge of the eastbound section of the United American Lines' service between the east and west coasts of the United States, has been appointed manager of the Philadelphia office of this company.

John A. Bailey, formerly with the Baltimore Dry Docks and Shipbuilding Company, Baltimore, Md., has been appointed assistant manager of the department of maintenance and repairs, United States Shipping Board, New York, succeeding Commander V. V. Woodward, who has returned to the Navy Department.

Dennis A. Maloney has been appointed special representative of the United States Shipping Board at Buenos Aires, Argentina. Captain Maloney has served as an American shipmaster for a number of years and has also had a wide experience in ship repair work, stevedoring and other branches of the shipping industry.

OBITUARY

George Simpson, naval architect, New York, died suddenly on August 22 from heart disease, aged fifty-seven years. Mr. Simpson was born in Colon, Scotland, and received his education in the Colon University and the Architectural Institute of Colon. For several years he was designing draftsman at the works of the Fairfield Shipbuilding Company. Later he was naval architect and works manager of J. S. White & Company, Cowes, Isle of Wight. Coming to this country he was placed in charge of the drafting room of the New York Shipbuilding Company, Camden, N. J., soon after the opening of the plant. Three years later he became chief draftsman at the Fore River Shipbuilding Company, Quincy, Mass. For the past nine years he maintained an office as a naval architect in New York. Several features of ship construction were introduced by Mr. Simpson, including an improved topside tank construction, modified transverse framing and the "bilge tunnel." Mr. Simpson was an occasional contributor to the literature of shipbuilding and naval architecture and was the author of "The Naval Constructor."

Frank F. Boulton, president of the Federal Steamship Line, died recently at his home in Brooklyn, N. Y. Mr. Boulton was born on Staten Island fifty-one years ago and throughout his business career has been engaged in the shipping business. He was president of the Maritime Association of the Port of New York; vice president and chairman of the board of the National Dry Dock Company; president of the F. F. Boulton Company and a director of the American Merchant Marine Insurance Company.

NEW BOOKS

The Port of New York Annual, Second Edition. Published by Smith's Port Publishing Company, New York. Cloth, 528 pages; size, 8x11 inches. Illustrated and indexed.

The main features of this second Port of New York Annual consist of: 1. A series of studies from data accumulated by the U. S. Shipping Board, but never compiled by it, the tabulation in this case being made for the Port of New York Annual, exclusively, by an expert. These studies cover a retrospective review of the foreign commerce, the handling of grain, coal and fuel oil at American seaports, how ships spend their time in port and the cost of loading and unloading at different seaports. 2. An illustrated description of the twin vehicular tunnels under the Hudson, contributed by T. Albeus Adams, chairman of the New Jersey Vehicular Tunnel Commission. 3. A mass of up-to-date information regarding the new "Port Authority," which is about to come into control and administration of the entire Port of New York, under the auspices of the States of New York and New Jersey.

Elements of Map Projection with Applications to Map and Chart Construction. By Charles H. Deetz, cartographer, and Oscar S. Adams, geodetic computer. Special Publication No. 68, U. S. Coast and Geodetic Survey. Pages, 163, frontispiece. Size 7½ by 11¼ inches. Figures, 74; 8 folded plates. Washington, D. C., 1921: Government Printing Office.

The whole field of cartography, with its component parts of history and surveys, map projection, compilation, nomenclature and reproduction, is so important to the advancement of scientific geography that the selection of suitable map projections is receiving far more attention than was formerly accorded to it. The exigencies of the problem at hand can generally be met by special study, and, as a rule, that system of projection can be adopted which is ideal or most useful for the area under consideration.

This volume is a comprehensive treatise on all the more useful projections, presenting them in as simple a form as possible in their general characteristics, mathematical development and actual construction.

Part I of the book covers the subject in general without the employment of any mathematical formulas and serves as a stepping stone to Part II, an arrangement which, it is believed, will best meet the needs of the student and the chart-producing agencies. In the selection of projections for present-day use in Part II, the authors have limited themselves, with two exceptions, to two classes, viz., projections that are *conformal* and projections that are *equal-area* or *equivalent*. The exceptions are the polyconic and gnomonic projections—the former covering a field entirely its own in its general employment for field sheets in any part of the world and in maps of narrow longitudinal extent, the latter in its application and use to navigation.

Shipping and Ship Operation News

Changes in Steamship Routes — Passenger and Freight Activities—Launchings and Other Notes of General Interest

Trade Improvement Continues As American Shipping on Pacific Coast Holds Previous Betterment

New Services and New Carriers Added to Handle Intercoastal and Foreign Trade—Increased Business for Various Products—Thirty Ships to Handle 5,000,000-Bushel Wheat Contract

Further indication of the steady revival of American shipping on the west coast is seen in reports from Seattle, Wash., of the addition of two new services and several new carriers to handle trade in Puget Sound's intercoastal and foreign trade. The *Mongolian Prince*, due to sail from Seattle to the United Kingdom and continental Europe about the middle of September, inaugurates the new service of Furness-Withy & Co. and will carry northwest flour, wheat, canned goods, lumber and general merchandise to London and Antwerp. Entrance of the Compagnie Generale Transatlantique into the trade between Puget Sound and European ports has been announced by the Transocean Company, agents for the French Line on the Pacific Coast. Regular monthly sailings are to be maintained beginning in November. Increasing the fleet of the European Pacific Line of the Shipping Board to twelve carriers, the Chinese built freighter *Celestial* has been assigned to service between Seattle on the Pacific Coast and ports of Europe. The *Celestial* loaded flour, lumber and other freight for London, Liverpool, Glasgow, Hamburg and Antwerp. The barkentine *Catherine MacKall*, of the W. L. Comyn & Co. fleet, is to take northwest products to South Africa. This is the first time in ten years a sailing vessel has been on berth on the west coast to carry general cargo to this destination.

Greatly increased bookings on apples for northwest states through Seattle have been the result from the lowering of steamship freight rates on apples to $1.00 a hundred pounds from Puget Sound to Atlantic ports and to $1.00 a box to Europe. According to reports, shippers can export apples through Seattle to Europe and save 37 cents a box over the route from Yakima and Wenatchee valleys to Atlantic ports by rail and thence across the Atlantic. Yakima County, 120 miles from Seattle, expects to ship 13,000 carloads of apples this year. The short haul from Yakima to Seattle costs 16 cents and with $1.00 for freight and refrigerator space to Europe makes a total of $1.16 a box. Shipment from Yakima under ice from the Atlantic Coast costs 88 cents a box, according to statements of growers; refrigerator space across the Atlantic is 65 cents, making a total of $1.53 a box and giving Seattle's water route a 37 cents differential

Seattle's import and export trade with Atlantic Coast ports by the all-water Panama Canal route totaled $10,051,458 the first seven months of 1921, compared with $4,695,472 for the same period of 1920. The Seattle import products valued $4,731,110 from the Atlantic Coast on the all-water route, while figures for the first seven months of 1920 were $639,557. During the first seven months in this year Seattle exported northwest products valued at $5,320,348 to Atlantic Coast ports as compared with $4,055,925 during the same period in 1920. Imports accordingly increased more than $4,000,000, while exports showed a gain of more than $1,000,000.

The steamship *West Botus* recently discharged 10,000 bags of green coffee at Seattle, emphasizing the increasing coffee trade resumed between Puget Sound and the east coast of South America. The vessel is in the Pacific, Argentine and Brazil service of Swayne & Hoyt.

Announcement is made of the signing of contract between the port of Seattle and J. A. Pease, representing Eastern capital, whereby 5,000,000 bushels of wheat, enough to fill 30 ocean steamships, will be moved annually through Seattle, making Puget Sound a great wheat exporting center. It is believed that most of this year's 5,000,000 bushels will move out of Seattle, Wash., before Christmas and the first shipments are now being moved. Other interesting figures on the improvement of shipping on the west coast show that a solid train load of 28 cars of milk, condensed by the Carnation Milk Products Company of Seattle, was recently shipped from Puget Sound to New York to be transported to England; Seattle's import and export trade with Germany during the first seven months of 1921 amount to nearly $700,000 as compared with none for the same period of 1920.

Reduction in Passenger Rates

Announcement has been made by the United States Lines of a reduction of $25 in third-class passenger rates to apply to all steamers of the company.

MOTOR BOAT SHOW

To Be Held in Grand Central Palace February 17 to 25, 1922

At a meeting of the show committee of the National Association of Engine and Boat Manufacturers, held Monday, August 29, at the offices of the organization, 29 West 39th Street, New York, it was decided to hold the 17th National Motor Boat, Ship and Engine Exposition in Grand Central Palace, February 17 to 25, 1922. This is the second big exposition committee to announce a Palace Show for 1922, the National Automobile Chamber of Commerce securing space last month, for its annual display of passenger cars and accessories in January. The motor boat display will occupy two floors in the Palace building and the industry in all its ramifications will be exhibited.

Immediately after the decision of the show committee, Ira Hand, who has managed the big motor boat shows held in New York City, left for Detroit. Undoubtedly the manufacturers and builders will welcome Hand with enthusiasm, for up until a month ago it was doubtful if there would be another motor boat show held in New York City because of lack of suitable building accommodations. It was announced last year that no more exhibitions would be held in the Palace, as the building was to be made into an office building. The exhibition committee in charge of the details of the exposition is composed of the following motor boat men: John J. Amory, chairman; James Craig, Charles Criqui and Henry R. Sutphen, the last named being president of the National Association of Engine and Boat Builders.

Maritime Capacity of Marseilles Is to Be Doubled

Marseilles, which is already the most important port and the second largest city in France, is to have its present maritime capacity doubled, according to advices just received by the Bankers Trust Company of New York, from its French Information Service.

The Societe Marseillaise de Credit reports that constructional work on the project is already under way. The task of doubling the port's capacity is indicated by the size of the present port. With its 10 basins it covers about 780 acres and comprises about 15 miles of wharf and 36 miles of railroad. The very complete dock equipment numbers, among other things, one 120-ton crane.

The amount of navigation, which had fallen off to a considerable extent, is rapidly regaining its pre-war volume. In 1913, 17,278 ships.

Steamship Interests

It is announced that Williams, Dimond & Company have acquired the 11,000-ton Shipping Board steamer *West Greylock*, built at Los Angeles. The company will place the vessel in the Oriental service for a trip or two and then will operate her to Europe and coast points.

A monthly freight service was established by the Compagnie Generale Transatlantique between Bordeaux and San Francisco with the sailing on September 5 of the steamship *Ontario* from Bordeaux, for Cristobal, Corinto, La Libertad, Mazatlin and San Francisco.

The United States Navigation Company, New York, has announced three Smith Line Boats, the *Winifried, Bradford City* and *Union City*, for freight service between New York and Hamburg. These vessels will sail at intervals of two weeks beginning on September 24.

A successful trial of the Peabody burner system in the electric drive ship *Independence* has been completed by the Shipping Board Trial Board, H. B. Taylor being the chief engineer in charge. On the first trials of the *Independence* difficulty was encountered in maintaining the desired steam pressure and it was stated that the trouble was due to water in the fuel oil, which has now been rectified.

The passenger liner *Bayern* of the Hamburg-American Line was scheduled to sail from Hamburg for New York on September 15, thus being the first passenger steamer flying the German flag to arrive at New York since August, 1914. According to an arrangement made between the United American Lines and the Hamburg-American Lines two more German vessels and three American steamers will compose the fleet plying in this service.

Construction of the new passenger liner *Statendam* of 32,000 tons, has begun at the yards of Harland & Wolff, Belfast, as part of the extensive program of the Holland America Line for enlarging its fleet. It is expected the vessel will be launched in 1923. Harland & Wolff are also building for the same company two 18,000-ton ships and the engines for twelve smaller vessels one of which has been completed.

The Agwi Steamship Lines report net earnings for the first six months of $1,349,037. This profit was obtained principally from operation of the company's tanker fleet, combined with earnings of the Clyde, Mallory, Ward, New York & Porto Rico and Southern lines, and was entirely independent of the operations of the Atlantic-Gulf Oil Corporation. The showing was aided by favorable charter rates prevailing early in the year on the tankers.

A new general cargo service was started the latter part of August by the New York Sydney Steamship Lines. The first steamer sailed from New York for Sydney on August 25 and there will be regular sailings in the future. Officials of the company state that important business interests in New York and Sydney have promised their support to the new venture and that they believe the volume of business between the two countries will show a steady increase.

It is reported that the Furness, Withy Company has established a new monthly freight service between the Pacific Coast ports of North America and Europe, to be known as the Furness, Prince Line. The *Mongolian Princess*, the first ship to ply in this service, is already under way with a Pacific Coast port as its destination. This new service will specialize in the carrying of meats, citrus fruits and other perishable cargoes, and one ship with refrigeration facilities has already been provided.

The Barr Shipping Corporation, 25 Beaver Street, New York, has announced the following freight rates for the coming season on shipments from New York to ports of the United Kingdom, to take effect beginning August 25:

Barrels of apples and pears, ordinary stowage, $1.25; refrigerator stowage, $1.75; boxes, ordinary stowage, 45 cents; boxes, refrigerator stowage, 65 cents; half boxes of pears and plums, refrigerator stowage, 40 cents.

It is reported from Seattle that the Compagnie Generale Trans-Atlantique will inaugurate a monthly fast freight service between North Pacific and French Atlantic ports next November. Eight steamships, the names of which have not as yet been announced, will be placed in this service, but it is understood that the vessels will be of 12,000 tons cargo capacity and have a speed of 13 knots. It is probable that, if business warrants, passenger service will be put on the route.

The Gulf & Intercoastal Steamship Company, Houston, Tex., plans to inaugurate a passenger and freight service between Houston and Corpus Christie starting on September 15, on which date an initial schedule of five trips a month will be announced. The main office of the firm will be in Houston, but the Corpus Christie terminal will be equipped with wharves, warehouses and such other permanent equipment as the business appears to justify. A steam vessel having cabin accommodations for sixty passengers and a cargo carrying capacity of 150 tons will be placed on this route.

Jos. A. Nash, North American Manager for the Lloyd Royal Belge, Belgium's largest steamship company, recently made the statement that he finds trade with the United States improving. Mr Nash states: "The increase in cargoes is small and slow, but there is an increase. This sort of growth is better than sudden inflation. I have reports from various parts of the country that great exporting industries are preparing for brisk winter business. To say that conditions have not yet reached the bottom of depression is unjustified. They have begun to rise from their lowest point and are climbing upward in a firm movement."

It is announced that the firm of Sea Carriers, Inc., will inaugurate a new regular steamer service between points on the Atlantic seaboard and Pacific ports with the sailing from New York on October 1 of the American steamer *A. L. Kent*. Five vessels will be put on this route, including the steamers *Felix Tausig, William A. McKenney* and *Thomas P. Beal*. It is expected that the vessels will stop at all the usual Pacific ports from Los Angeles to Seattle, and possibly the Canadian ports. Houlder, Weir & Boyd, 42 State Street, New York, will be general Atlantic Coast agents for the company.

Marking the active entry of another Japanese steamship line into the competition for export and import trade through Seattle, Wash., the Yamashita Kisen Kaisha Steamship Company's frighter *Yoshida Maru* No. 1, berthed at Seattle September 2, is scheduled to be followed by two other ships of the same company.

August 31, 1921, marks the 25th anniversary of the Nippon Yusen Kaisha Steamship Company service between the Orient and Seattle, its American terminus. During the twenty-five years 608 "N. Y. K." steamships have touched at Seattle, bringing in more than $2,500,000 of imports and carrying out over $3,000,000 of exports.

The Clyde-Mallory Lines announce the inauguration of a new service between Baltimore and New York with the sailings from New York on October 12 of a steamer for Baltimore, and on October 15 from Baltimore for New York. The steamships *Norfolk* and *Philadelphia*, each of 2,500 tons, have been chosen for this service and will continue regular weekly sailings on Wednesday and Saturday of each week. Increased business between New York, Charleston and Jacksonville has caused the Clyde-Mallory Lines to add two more vessels to this route, thus making possible four sailings weekly, instead of three as heretofore.

Porto Rico Line Announces Reductions in General Cargo Rates

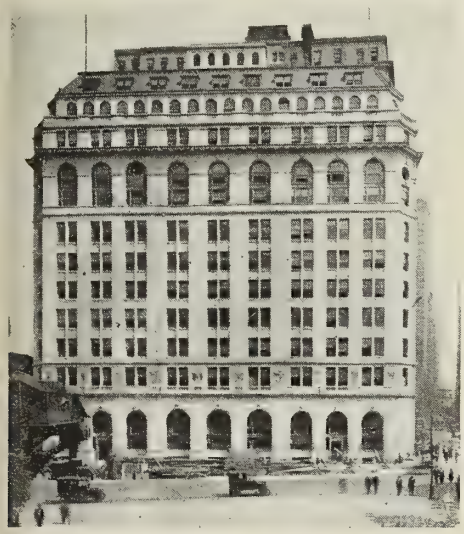
The Porto Rico Line, 25 Broadway, New York, announces a general reduction in south bound and north bound general cargo rates between New York and Porto Rico and between New Orleans and Porto Rico. The average reduction is slightly in excess of 10 percent, although on some commodities the reduction has been greater, the latter list including fertilizer, from $9 to $7 per ton; cement, from $1.25 to $1 per barrel and tobacco, from 20 cents to 16 cents per cubic foot.

It is stated that these reductions give the island of Porto Rico the benefit of a freight tariff which averages 40 percent lower than the freight rates applying between North Atlantic ports and other similar ports in the West Indies. A list of the reductions on some of the more important commodities is as follows:

	From	To
Packing house products	63c per 100 lbs.	60c per 100 lbs.
Fertilizer	45c per 100 lbs.	35c per 100 lbs.
Cement (per bbl. 400 lbs.)	$1.25 each.	$1 each.
Fish dried, pickled.	63c per 100 lbs.	60c per 100 lbs.
Foodstuffs	50c per 100 lbs.	45c per 100 lbs.
Machinery	31c per cu. ft. or 75c per 100 lbs.	28c per cu. ft. or 69c per 100 lbs.
Lumber, per M. F.		
White pine, rough	$16.25 M.	$14.50 M.
Dressed yellow pine.	$20 M.	$18 M.
Oak hardwood	$22.50 M.	$19 M.
Oil, kerosene (per bbl.)	$2 each.	$1.85 each.
Ten gallon case.	44c each	40c each
Automobiles, pleasure.	31c cu. ft.	28c. cu. ft.
Furniture	28c cu. ft.	25c cu. ft.
Dry goods	31c per cu. ft. or 75c per 100 lbs.	28c per cu. ft. or 69c per 100 lbs.
Silks	38c per cu. ft.	35c per cu. ft.
Vegetables	63c per 100 lbs.	60c per 100 lbs.

I. M. M. to Occupy New Quarters at No. 1 Broadway

Announcement is made by the International Mercantile Marine Company that it expects to occupy its new quarters at No. 1 Broadway, New York City, in November, which serves to call attention to the renaissance of one of the most interesting business structures in New York.



New Offices of I. M. M.

The booking office is designed to represent the latest ideas in practical utility, with extensive counter space, a waiting room for customers, a department devoted to the issuing of travelers' checks, and a section for the distribution of travel literature.

One strikingly modern feature of the booking office will be a small motion picture theatre, for the projection of films portraying life on the company's ships when on the Atlantic passage or tropical cruises.

Four floors above the booking office will be occupied by executive offices of the company and its constitutent lines, including a floor devoted to the accounting department, another to freight, another to operating, and the fifth to the general offices of the company and their clerical staffs, and the board room.

On the Greenwich street level will be the third class department, with extensive counter space, offices, waiting rooms, etc.

Operating Losses Cut to $5,000,000 a Month, Chairman Lasker Says

It is announced by Chairman Lasker that the Shipping Board has cut its operating losses to the point where they will not run above $5,000,000 a month, and that the end of the drain on the public treasury is now in sight. Enforcement of the Jones Act together with a moderate revival of trade, he stated would wipe out the operating deficit within the next two years.

The Board has made its plans to keep expenditures within the $100,000,000 budget for the current year and has asked for an appropriation of only $50,000,000 for the fiscal year beginning next July. It is the belief of Chairman Lasker that not more than $75,000,000 will be required for operations this year, and that the additional $25,000,000 will be used to complete construction, but should it be decided to recondition the *Leviathan,* it would make necessary an additional appropriation of $8,000,000 to $10,000,000. In explaining the budget of $100,000,000 for the current fiscal year, Mr. Lasker says that Congress has already appropriated $48,500,000 for operations and $25,000,000 for construction, leaving $26,500,000 which will be requested from Congress later as the need arises. He states that these two appropriations should tide the board over, providing that private owners can operate profitably under the indirect benefits that would accrue under the Jones law. No amount has been provided for the settlement of claims or the payment of the past debts which the board has assumed, but it is expected that past debts can be discharged through the collection of $20,000,000 now due the board.

MILLION DOLLAR JOB

St. Louis to Be Reconditioned for "I'll Tell the World" Trip

Specifications have been issued for one of the biggest repair contracts of the year—the reconditioning of the steamship *St. Louis* for the Anderson Overseas Corporation, 165 Broadway, New York City, at a cost estimated at close to one million dollars. For several weeks the ship has been at the yard of the James Shewan & Sons' Inc., Brooklyn, N. Y., pending the award of the contract. Among other improvements it is expected the steamer will be converted from coal to oil burning.

The *St. Louis* is a twin screw ship, has five decks and is propelled by quadruple expansion engines. She is 535 feet in length, with a beam of 63 feet and displaces 11,600 tons.

The completion of the reconditioning work is scheduled for December and the ship is to leave New York in January, 1922, for a "round the world trade cruise," bearing exhibits and representatives from American manufacturers and businessmen, and visiting all the principal countries of the world. The entire main deck and portions of the promenade deck have been set aside for exhibits and the open forward deck is reserved for heavy machinery. It is stated that the exhibition space amounts to approximately 30,000 square feet—equivalent to "taking Madison Square Garden around the world." The Anderson corporation is carrying forward extensive plans for the trip, which is to last a year and will be in the furtherance of American foreign trade.

The *St. Louis,* which will be painted white, will carry the slogan "I'll tell the world," and will have the following tentative itinerary:

Havana, Kingston, Pernambuco, Bahia, Rio de Janeiro, Santos, Montevideo, Buenos Aires, Cape Town, Port Elizabeth, Durban, Delagoa Bay, Mauritius, Perth, Adelaide, Melbourne, Sydney, Wellington, Yokohama, Tientsin, Shanghai, Hong Kong, Manila, Sagon, Surabaya, Samarang, Batavia, Singapore, Penang, Rangoon, Calcutta, Madras, Colombo, Bombay, Crachi, Aden, Port Said, Constantinople, Salonica, Genoa, Marseilles, Barcelona, Gibraltar, Cadiz, Lisbon, Boulogne, Southampton, Antwerp, Rotterdam, Hamburg, Gothenburg, Christiania, Bergen, New York.

New West Coast Freighter to Engage in Pacific-European Trade

Another 11,000-ton flush deck freighter, the *West Greylock,* built, engined and equipped at the plant of the Los Angeles Shipbuilding & Dry Dock Company, has been given her sea trials under the supervision of officials of the United States Shipping Board and of the building company.

The several tests to which a new vessel is subjected before being taken over from the builders by her owners occupy a full day at sea. There are speed trials, reverse speed trials, rudder tests, anchor tests, etc. In all of these the *West Greylock* passed to the full satisfaction of all concerned. In her speed trials without cargo, and therefore with her propeller half out of water, the freighter made an average of 11.87 knots for the six-hour test over the measured run. In this she did a shade better than her sister ships, the *West Faralon* and *West Lewark,* which have been sent out from the same plant during the last few weeks and which have already attracted much favorable comment from shipping men along the Pacific Coast.

The *West Greylock* is understood to have been chartered by Williams, Dimond & Company, the charterers of both the *West Lewark* and *West Faralon.* The two latter ships have been immediately placed in the Pacific-European trade. It is said that the *West Greylock* will be used by these international shippers for the long trip first to Oriental ports and then to Europe.

The particular point of interest to the shipping men apart from the good speed and economy in fuel shown by this type of freighter is said to lie in their provision and admirable arrangement of hatchways and cargo handling appliances. The design for the vessel was worked out at the plant of the builders following suggestions made by practical shipping men who had found that the docks of most ports were seldom provided with sufficient cargo handling machinery, consequently causing considerable delay and loss of time in unloading the cargo of a freighter. It was particularly to obviate this trouble that deck derricks were provided in quantity and capacity sufficient to assure rapid discharging of cargo, thus making the ship practically independent of the cargo-handling equipment of the ports at which she might call. While in San Francisco, recently, the *West Lewark,* the first of the five of this class of vessel now being built by the Los Angeles concern, found it possible to employ at the same time nine separate gangs of stevedores.

Keel Laid for Jap Tanker

In the presence of a number of Japanese and American officials the keel of the fuel supply ship *Kamoi,* which is to carry oil and coal for the fleet of the Imperial Japanese Navy, was laid on September 14 at the plant of the New York Shipbuilding Corporation in Camden, N. J. The ship will be of 20,000 deadweight tons, 496 feet in length and will have electric propulsion, the electrical equipment being supplied by the General Electric Company of Schenectady, N. Y.

Shipbuilding and Shipyard Development

What the Shipyards Are Doing—Dry Dock Notes —Port Expansion Plans—Engineering Projects

Millions to Be Spent for Construction and Equipment of Piers in Big Eastern Ports

Philadelphia and New York Have Vast Projects Under Way—Unusual Contract for American Made Equipment at New York—New Piers Progressing Rapidly

Bids for what is believed to be the biggest equipment contract so far this year amounting to close to $1,000,000 and covering the furnishing, installing and putting into successful operation of cranes, elevators, electric power transmission and steam-heating plants on Piers 12 and 13 at Stapleton, S. I., were scheduled for receipt at the office of Commissioner of Docks, Room 8, Pier A., foot of Battery Place, North River, New York City, at 12 o'clock noon on October 4, 1921.

The contract number is 1686 and the work is divided into four sections. Contract "A" provides for the installation of 34 cranes, the time allowed being 360 calendar days; contract "B" elevators, 180 consecutive calendar days; contract "C" electric power transmission, 120 consecutive calendar days; contract "D" steam-heating plant, 120 consecutive calendar days.

The Board of Estimate and Apportionment of the City of New York adopted on August 2, 1921, a resolution approving the amended plans and specifications for this work with the limitation that the equipment be of American manufacture, the estimated cost of the work being $911,800.

DEVELOPMENTS AT PHILADELPHIA.

At Philadelphia a contract is about to be placed by the Department of Wharves, Docks and Ferries, Bourse Building, for the construction of Pier No. 5, North Wharves, Philadelphia, which will replace old Piers Nos. 3, 4, and 5, North. The firm of Snare & Triest, now the Frederick Snare Corporation, was recently awarded the contract for the construction of the substructure of Municipal Pier No. 3, North Wharves, which contract calls for the tearing out of Piers Nos. 1 and 2 and the partial tearing down of Pier No. 3, North Wharves.

These piers will be combination piers for either the accommodation of transatlantic or coastwise and river traffic; each 185 feet wide by approximately 550 feet long, with all docks or waterways 215 feet wide, except that between the first Pier No. 3 and the ferry house on the south of it, in which the waterway will be 115 feet wide and will make one continuous improvement owned and constructed by the City of Philadelphia, extending from approximately 100 feet north of Market Street to the foot of Cherry Street, where Municipal Pier No. 9 North is located. The piers as well as the ferry house will be connected with a 32-foot wide bulkhead shed, one story high, except for a section at the north end, approximately 112 feet long adjacent to Pier No. 9 North, where a two-story shed will be built for office use. The substructures will be of permanent and massive design and of a type known as the "Fill on Platform" which may be described briefly as:

Timber piling supporting a timber deck covering the entire area of the pier near the low water level which in turn supports a dry fill deposited on the decking and brought up to the level of the main pier deck and retained by concrete walls built on the low level decking along the sides and ends of the pier.

The superstructures will be two-story steel and concrete sheds of modern construction throughout, enclosed on the dock sides with an approved type of turnover cargo doors and terra cotta tile walls, and will be thoroughly equipped with cargo masts, electrically operated elevator winches, chutes, spiral conveyors and other improved cargo handling apparatus. Double car tracks leading from the Philadelphia Belt Line Railroad in Delaware Avenue will extend into the sheds for nearly the entire length of the piers, and will be depressed so that the car floor will be approximately at the same level as the pier main deck. The first deck will be designed for a loading of 600 pounds per square foot, and the second deck for 300 pounds per square foot.

The facades of the piers and bulkhead sheds on Delaware Avenue and the river end elevations will be architecturally treated in brick and terra cotta, and when completed the Delaware Avenue front of the terminal, in conjunction with Cherry Street Pier, to which it connects, will present an unbroken elevation more than 1,000 feet long. This improvement will be known as the Girard Pier Group.

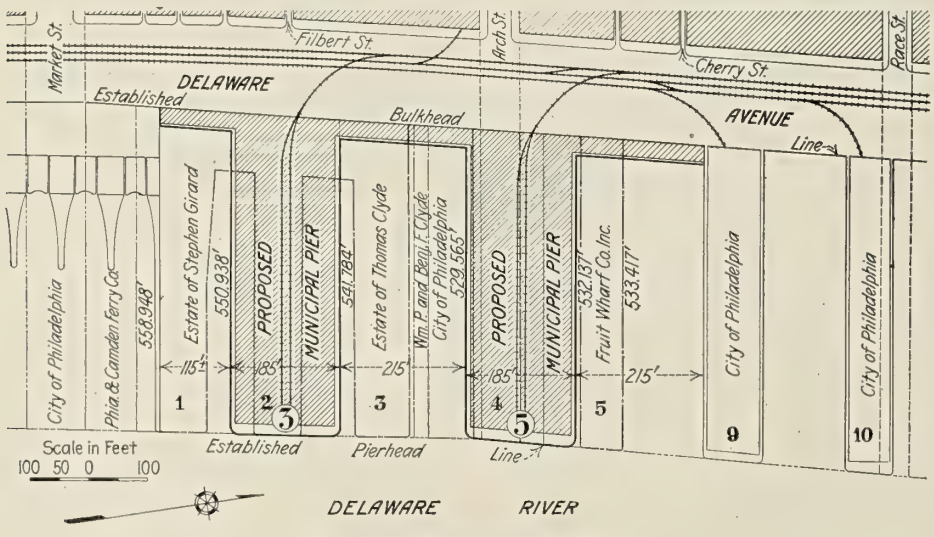
CONTRACT AWARD.

A contract was awarded to the J. S. Rogers Company, Philadelphia, on September 12, 1921, by the Department of Wharves, Docks and Ferries, Philadelphia, for the construction of the superstructure for the Chestnut Street Pier, No. 4, South Delaware Wharves, amounting to $340,000.

The sub-structure for this pier—80 feet wide by 550 feet long—is of permanent construction throughout. The McLean Contracting Company, Baltimore, Md., was awarded the contract for the construction of the sub-structure in the early part of the year.

The superstructure, to be built by the J. S. Rogers Company, is a double-decked steel and concrete building, inclosed on the deck sides by brick-faced terra cotta walls. The lower deck will be equipped for the accommodation of river steamers and the upper deck for offices of the department.

Architectural brick and terra cotta will be used for the inshore and outshore elevations, designed by the City Architect in conjunction with the Engineering force.



Proposed Philadelphia Piers

New Steel Ferryboat to Be Built for Jamestown and Newport Ferry Company

Plans and specifications have been completed for a steel, double ended screw ferryboat for the Jamestown-Newport Ferry Company, Newport, R. I. The general dimensions of the proposed steamer are: length overall, 150 feet; length between perpendiculars, 123 feet; beam over guards, molded, 48 feet; beam overall, 49 feet; depth, molded, 14 feet; draft, 8 feet. The cost was estimated at close to $200,000.

The steamer will be equipped with a compound engine and Babcock & Wilcox boilers, electrically lighted and steam heated. She will be equipped to meet the requirements of the United States Steamboat Inspection Service. Accommodations will be provided for 500 passengers and 32 average sized automobiles.

Five Million Dollar Expansion Is Planned for the Port of Norfolk, Va.

The Norfolk Port Commission has just advised the City Council that the port development work being planned by the commission will cost in the neighborhood of five million dollars. Barton Myers, chairman of the commission, has recommended that the council consider the question of a bond issue for these improvements for submission to the voters of this city at the November election.

Plans have been drawn, under the direction of the commission, for pier, warehouse and grain elevator facilities, which will cost upwards of four million dollars, and a small boat terminal is also contemplated. The piers, warehouses and elevators will be constructed on property now owned by the city of Norfolk fronting a half-mile on Hampton Roads.

Steamer Pennant to Be Remodeled

The motor tanker *Pennant,* of 3,253 gross registered tons owned by the Pierce Navigation Corporation, 25 Broad Street, New York City, is to be reconditioned, bids for the work being scheduled for receipt on October 3. The ship is to have two Bolinder engines including shafting, thrust, clutch and exhaust piping, also auxiliaries and all their appurtenances removed. The interior of the ship is to be constructed to accommodate steam engines and boilers with necessary auxiliaries, rearrangement of after quarters and construction of new bridge house amidships and will be completed in every detail as a twin screw steamer.

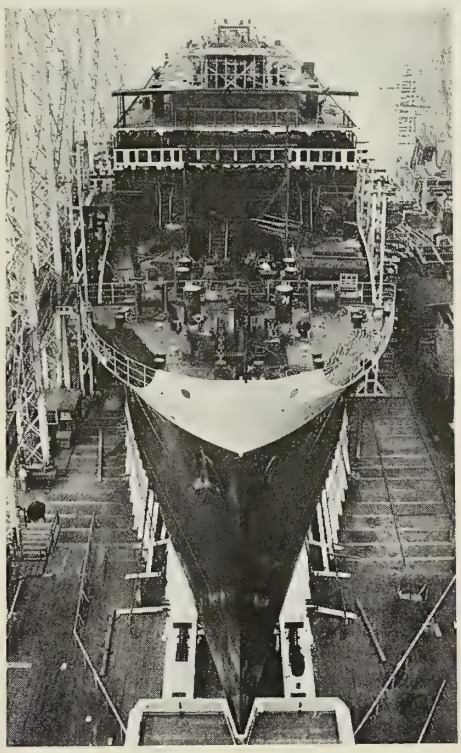
Momus Back in Service

Following the reconditioning of the Southern Pacific (Morgan Line) steamship *Momus,* during which the steamer was converted into an oil burner, regular weekly sailings in each direction between New York and New Orleans were scheduled for resumption on October 1, according to an announcement by L. J. Spence, director of traffic of the Southern Pacific Lines. The sailings will be on Saturdays from New York and on Wednesday from New Orleans.

MUNARGO LAUNCHED

New Ship Takes Dip at Camden, N. J., for Munson Line

The *Munargo,* a freight and passenger steamer, built for the Munson Steamship Line at the Plant of the New York Shipbuilding Corporation, Camden, N. J., was launched Saturday afternoon, September 17, 1921, at 3:10 o'clock.



S. S. Munargo on the Ways

The overall dimensions of the ship are 432′-3″ in length, beam 57′-6″ and depth 34′-6″. It accommodates 172 first class passengers, 56 second class and 50 steerage passengers, together with a crew of 112 men. The cargo carrying capacity for baled cargo is about 299,060 cubic feet, and for grain about 325,000 cubic feet. At load draught the vessel is capable of making 15½ knots per hour. It will be operated between New York and the Central American Ports.

New York City Fireboat

The fireboat *John Purroy Mitchel,* being built by the Standard Shipbuilding Corporation at their yard, Shooters Island, N. Y., is nearing completion and it is expected will go on its trial trip in the near future. The dimensions of this fireboat are as follows:

Length, 132 feet; beam, 27 feet; depth, 14 feet, nine inches.

Henry J. Kimman Dead

Henry J. Kimman, since 1902, manager of the Cleveland plant of the Chicago Pneumatic Tool Company, died in Cleveland, Ohio, September 7. He was born in Harlem, Holland, in 1863 and emigrated to America with his parents and settled in Chicago in 1870.

He designed and in collaboration with his brother built the first practical portable piston air drill, known as the "Little Giant."

73 SHIPS IN AUGUST

Electric Yacht Included in 78,415 Gross Tons Built and Numbered

The Bureau of Navigation, Department of Commerce, Washington, D. C., reports 73 sailing, steam and unrigged vessels of 78,415 gross tons built in the United States and officially numbered during the month of August, 1921. The list includes one electric yacht of 508 gross tons and of the total number four vessels of 34,973 gross tons were built for the United States Shipping Board. The steel ships *Southern Cross* and *John D. Archbold,* the former of 13,741 gross tons, built at Camden, N. J., for the United States Shipping Board, and the latter a tanker of 13,500 gross tons built at Newport News, Va., for the Standard Oil Company, are among the largest vessels included in the list.

The steamships *Emile Deutsch de la Meurthe,* 16,072 gross tons, and the *San Leonardo,* of 5,718 gross tons, are included in the above figures, but were built in this country for foreign owners during the month of August.

Navy Resumes Construction Work on Battle Cruiser

Another bright spot in the shipping situation is seen in the announcement by vice-president G. E. Emmons, in charge of manufacturing of the General Electric Company, Schenectady, N. Y., that the Navy Department has authorized the resumption of work on electrical equipment for one battle cruiser, and hope is expressed that a similar arrangement can be made with respect to a second ship. With regard to the decision of the Navy Department to resume some of its construction work Mr. Emmons said:

"The Navy Department has authorized the resumption of work on electrical equipment for one battle cruiser, with the understanding, however, that shipments will not be required until next summer and no payments for materials and labor are to be made until the next government fiscal year which begins July 1st, 1922.

"This necessitates the company locking up capital for materials and labor until next July, but it gladly does it in order to provide employment to those who would otherwise be out of work during the coming winter.

"When the resumption of work is fully underway, about 500 additional hands will be given employment. It is hoped that a similar arrangement can be made with respect to equipment for another cruiser, which, if successful, will provide work for an additional number of hands."

River Tug Planned

The Mexican Petroleum Company, 120 Broadway, New York, is contemplating the construction of a stern wheel towboat for use in southern waters. The boat, it is understood, will be about 135 feet in length, with a draft of 54 inches, and driven by a single condensing engine. Steam will be supplied by two oil-fired boilers.

Submarine S-51, Latest of Her Type, Is Launched by Lake Torpedo Boat Company at Bridgeport, Conn.

Newest Undersea Fighter Takes Initial Plunge While Flock of Carrier Pigeons Hover Overhead—Birds Near Messages of Hope That Congress Will Continue Construction Program

The submarine *S-51* was successfully launched recently at the yard of her builders, The Lake Torpedo Boat Company, Bridgeport, Conn. Mrs. R. P. Mills, wife of the manager of the estimating and cost department of that company, acted as sponsor.

This company in launching its submarines usually presents some novelty by which the event can be remembered, and this launching was no exception. The sponsor, immediately after breaking the bottle of champagne over the bow, threw into the air a single carrier pigeon as a signal to the submarine then sliding down the ways, and the men on board dropped the bar releasing the covers of eight massive crates, and just as the *S-51* hit the water for the first time, four hundred and sixty carrier pigeons sailed into the air in a great cloud, circled twice over the heads of the launching party, then straightened out in all directions and were soon lost to view on their flight to various places with the messages attached, to the effect that the "*S-51* was successfully launched that day, the last of her type. Now ready for new construction which it is believed Congress will provide."

CONSTRUCTION

The *S-51* is a double-hulled submarine, regarded by naval constructors as embracing the latest word in submarine construction and development. She is one of ten vessels of the *S-42* to *S-51* group and is the last of four to be built by The Lake Torpedo Boat Company, the other three having been launched and nearly completed.

These vessels were authorized in 1916; however, the order to build was not given to The Lake Company until July 1, 1919.

DESIGN

The design for this class is regarded as a logical development of the *S-3* design and embodies the latest features and improvements known to submarine construction as a result of operations during the World War. To accommodate these new features it was necessary to increase the length of the vessel, thereby increasing the displacement from about 875 to 993 tons. The *S-51* is 240 feet in length overall, with a maximum breadth of hull of 21 feet 6 inches and a draft of about 13 feet 6 inches in normal surface condition. The vessel is of double hull type for one-half the length amidships, the forward and after portion being of the single hull type.

She has been designed to withstand with safety a submergence to 200 feet. The vessel is propelled on the surface by two Diesel engines, each driving a screw propeller. These engines are rated at 950 brake horsepower each. Submerged, the vessel is driven by two electric motors. The armament consists of four 21-inch torpedo tubes in the bow and one 21-inch torpedo tube in the stern. A 4-inch, 50-calibre gun is installed on the deck, forward of the conning tower, and a gun access hatch to enable the gun crew to reach the gun quickly is provided.

Three periscopes are installed, one of which has its eyepiece in the conning tower, but arranged with a platform and trunk to permit the operator to ride up or down with the periscope and take observations at any height. The eyepiece of the other two periscopes are in the control room.

The *S-51* is equipped with radio apparatus, both for surface and submerged work, and with submarine coils for receiving radio messages submerged. Submarine oscillator signaling sets also are provided. Stowage for a 14-foot lifeboat is provided in the superstructure.

American Yards Building 542,117 Gross Tons of Seagoing Steel Ships

There was a total of 70 seagoing steel ships having a total gross tonnage of 542,117 building and contracted for, for the United States Shipping Board and private owners on September 1, 1921, according to statistics compiled by the American Bureau of Shipping. There was a river and harbor steel tonnage building and contracted for in the United States for private owners on September 1, totalling 68 vessels of 39,268 tons. Of the total American ocean ships, 40 were tankers, with a total of 317,204 gross tons, and 17 are cargo boats with a total of 107,951 gross tons. All of the tankers and 12 of the cargo boats are oil burning. These figures are for vessels of private ownership. The total of 8 ships with a gross tonnage of 84,000 building for the Shipping Board are of the passenger and cargo type oil burning, and 3 of 21,900 gross tons are cargo carriers using coal and oil fuel.

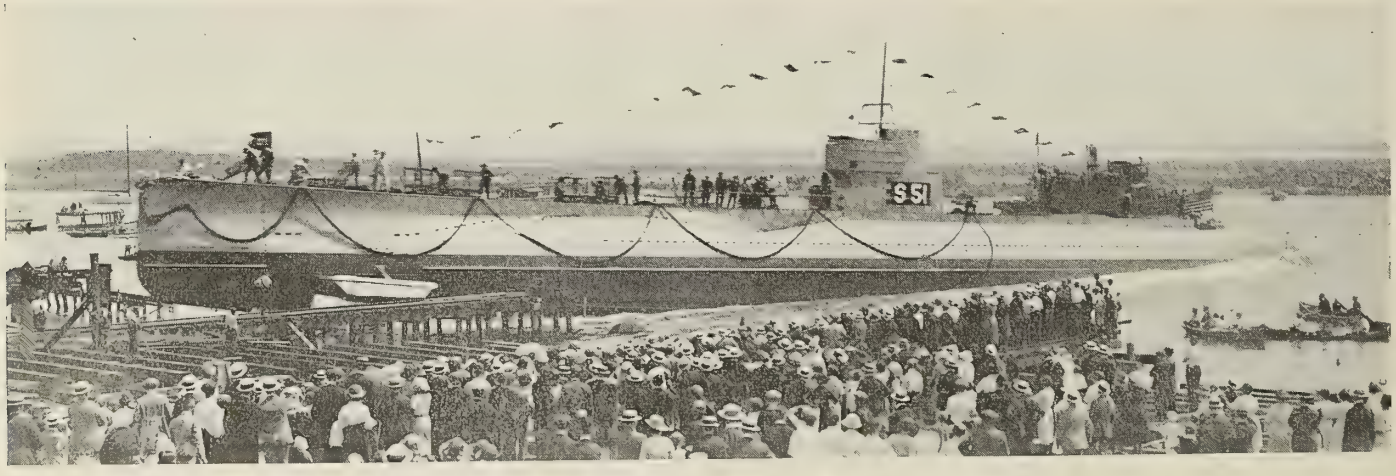
It is also set forth that of the total seagoing steel tonnage building in the United States for the Shipping Board and private owners a total of 48 ships with a gross tonnage of 389,079 are on the Atlantic Coast; 18 ships of 125,438 gross tons are on the Pacific Coast, and 4 ships of 27,600 gross tons are on the Gulf Coast.

In addition to the above figures the Shipping Board is having built in China 2 ships having a total of 14,000 gross tons.

Swedish Cruiser Has Successful Final Trials

Word has been received by the Westinghouse Electric & Manufacturing Company that the final trials of the new Swedish cruiser *Drottning Victoria,* which is propelled by Westinghouse geared turbines, proved highly successful.

The *Drottning Victoria,* and her uncompleted sister ship, *Gustaf V,* are propelled by two 22,000-h. p. turbines of the divided flow type. The gears were built at the East Pittsburgh Works of the Westinghouse Company, and the turbines were built according to Westinghouse design by the Motala Verkstads Nya Aktiebolag of Motala, Sweden.



Launching of the Submarine S-51 at Bridgeport, Conn.

Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Damage to Lightship No. 41, Boston.—Vineyard Sound lightship No. 41 was damaged to the extent of several hundred dollars recently by being run into by the barge Malvern, which the tug Triton was towing from New York to Boston.

Steamer Bristol Awarded, Brooklyn, N. Y.—The contract for repairs to the United American Line's steamship Bristol has been awarded to the Crane Dry Dock & Repair Company, at a price of $16,900 and fifteen days' time.

Oil Heating System for Three Ships, New York.—The contract for the installation of a fuel oil heating system on the United American Line ships Panaman, Floridian and Ohioian has been awarded the National Dry Dock & Repair Company on a bid of $12,750. The National Dry Dock & Repair Company was also awarded a contract for repairs to the steamer Norfolk, of the same line. It is understood that the work will cost close to $12,000.

Ferry Repair Contract, Brooklyn, N. Y.—James Shewan & Son, Inc., has been awarded a contract for dry docking and overhauling nine municipal ferryboats of the City of New York. The company was low bidder for the job with a price of $14,935.

To Equip Sub Chaser as Yacht, Vancouver, B. C.—It is reported that A. M. Dollar of the Dollar Steamship Company, having brought the hull of a sub chaser up to Vancouver, B. C., from Bremerton, will soon let a contract to a local shipyard for the conversion and equipping of the hull into a first class yacht.

Inquiry for Barges, Cuba.—A report is current in marine circles that H. Pita, Esq., of Caibarien, Cuba, is considering the placing of an order for two oil barges having a capacity of about 100,000 gallons each, and a wooden schooner.

Pontoons and Barges, St. Helens, Oregon.—It is reported that the St. Helens Shipbuilding Company was awarded a contract to build sixty wood pontoons for the engineer department of the Army. The company also has contracts for several large barges.

To Repair Schooner, Seattle, Wash.—Amundsen's exploring schooner Maud has arrived at Seattle for repairs as well as a complete overhauling and outfitting prior to starting on its next Arctic exploration trip in the spring. This vessel was recently rescued from the Arctic by the United States revenue cutter Bear after having been virtually stripped of her propeller blades.

To Build Barges.—It is reported that Henry Ford is considering the operation of a fleet of self-propelled freight barges between Detroit and the Atlantic seaboard by way of the Erie Canal. Construction of these barges will soon be commenced and they will be so designed as to handle the entire seaboard freight of the Ford Company.

Will Recondition Steamer, Montreal, Can.—It is reported that the passenger steamer Narragansett, owned by the Canada Steamship Lines, Inc., will soon be extensively reconditioned for service on the St. Lawrence river. The vessel is a sister ship of the DeWitt Clinton, recently remodelled for the Hudson River Day Line.

To Build Ferryboats, San Francisco, Cal.—The Union Plant of the Bethlehem Shipbuilding Corporation has been awarded the contract for the construction of three ferryboats for the Six Minute Ferry Company, to cost $1,000,000. These vessels when completed will ply between San Francisco and Oakland.

Steamer Frednes Awarded, Brooklyn, N. Y.—At a price of $15,814 the Ramberg Dry Dock Company has been awarded the steamship Frednes from Porsgrund, Norway. The vessel is to be reconditioned and brought up to Lloyd's Classification, the work being handled by the firm of Macfarlane, Garmey & Company, 32 Broadway, New York.

Shipyard for Sale, New Orleans, La.—It is reported that the plant of the Dollut & Williams Shipbuilding Company is being offered for sale. This yard was established in 1918 for building steel vessels and has four launching ways.

To Enlarge Plant, New Orleans, La.—It is reported that the Jahncke Ship Repair Company is negotiating for the purchase of the river front property occupied by the Jackson Barracks for proposed extensions to its plant.

New Shipbuilding Plant, Brooklyn, N. Y.—The Wheeler Company, care of the Graham Beach Realty Company, is reported as having acquired seventeen lots on Coney Island Creek, Flatbush, on which they propose to establish a new shipbuilding plant, specializing in the construction and repair of small vessels.

Plant Extensions, Algonac, Mich.—Although the Algonac Boat & Machine Company only recently completed an addition to its plant, greater capacity is again required and the company proposes extensions to the plant on the property adjoining it, and which was acquired for that purpose.

Will Recondition Schooner, New York.—The International Petroleum Company of New York has purchased the auxiliary schooner Irages at Tampa, Florida, and will renovate and equip her for special work in Mexico. Whittelsey & Whittelsey, consulting engineers and naval architects, 17 Battery Place, are the engineers in charge.

Launchings, Sparrows Point, Md.—The Nutmeg State, the last of twenty-three passenger liners being built for the Shipping Board, was launched from the ways of the Bethlehem Shipbuilding Corporation at Sparrows Point, Md., on September 17, while the West Chopeka, a 12,000-ton freighter, will go down the ways of the Los Angeles Shipbuilding & Dry Dock Company, thus marking the launching of the last merchant ship for the Government.

To Be Oil Burner, Alameda, Cal.—The steam freighter Pacifico will be converted into an oil burner at the yards of Barnes & Tibbetts, this company having been the lowest bidder for the work. The barkentine Olympic, owned by Thomas Crowley, is also at the yards of Barnes & Tibbetts for docking and overhauling, as well as the steam schooner Alliance, recently purchased at a United States Marshal sale for about $2,300, which is being recalled and thoroughly overhauled.

Deck Machinery, Elizabeth, N. J.—The Moore Plant of the Bethlehem Shipbuilding Corporation will construct the deck machinery for a 2,650-ton oil tanker, contract for which has been awarded to the Bethlehem Shipbuilding Corporation, Ltd. This machinery will consist of a 7 by 7 inch Bethlehem spring quadrant type steering gear with horizontal engines and 8¼ inch by 8 inch Bethlehem spur gear windlass suitable for taking 1¾ inch anchor chain and a 6¼ by 8 inch Bethlehem steam self-contained gypsey.

Contract Awards, Hoboken, N. J.—The W. & A. Fletcher Company has been awarded the contract for engine repairs and for the general overhaul of the structure, equipment and tanks of the steamship William Ison, of the American Italian Commercial Corporation. It is expected this work will cost close to $19,000. The same company has been awarded the United Fruit Company ship Carrillo, for overhauling of sea valves, bottom repairs and painting, and the steamer Mystic of the United American Lines, for survey, bottom damage and trip repairs.

To Recondition Steamer, Port Arthur, Ont.—The Port Arthur Shipbuilding Company is reported to have a contract for overhauling and repairing the steel steamship Francis Widlar which was recently refloated by the Reid Wrecking Company, Sarnia, from Pancake Shoals, Lake Superior, where she was stranded in the fall of 1920. The vessel, with a length of 416 feet, breadth 50 feet and depth 28 feet, is of 4,682 gross tons. It is estimated that the work of reconditioning this steamer will occupy about three months' time, and will be under the supervision of John Smith, naval architect, Cleveland, Ohio, on behalf of the Mathews Steamship Company, Toronto.

Passenger Liner Wanted, Seattle, Wash.—The Admiral Line, L. C. Smith Building, is reported to be in the market for a passenger liner to replace the steamer Governor which sank in Puget Sound several months ago. According to A. F. Haines, vice president of the company, no vessel has been obtained as yet, but if a suitable vessel for the coastwise trade could be secured, it would be added to this service. Some time ago plans were drawn for two fast liners for this company, construction of which was to commence as soon as shipbuilding costs dropped, but no further action has been taken in this direction.

Pump Installation.—The M. T. Davidson Company, 154 Nassau Street, New York City, manufacturers of steam pumps, have been awarded the contracts for the installation of pumps on the Philadelphia fireboat Rudolph Blankenburg, being built by the John W. Sullivan Company, and also for the second Philadelphia fireboat, not yet named, being built by the Merchant Shipbuilding Corporation, Chester, Pa.

The equipment to be installed includes a vertical twin beam air pump, 14 inches by 24 inches by 24 inches by 15 inches; two vertical simplex boiler feed pumps; one horizontal simplex fire and bilge pump, and one horizontal simplex sanitary pump. For the New York fireboat John Purroy Mitchell, a vertical beam twin cylinder air pump and two vertical duplex boiler feed pumps are being supplied by the same company.

Activity at South Jacksonville, Fla.—The yard of the Gibbs Gas Engine Company, South Jacksonville, Fla., is showing increased activity with sixty percent of its normal working force re-employed and more being added. The company is building a sloop yacht for a prominent local business man. The vessel is to be one of the finest cruisers turned out in some time. The company is also doing a great deal of repair work and at present has in dry dock the motor houseboat North State which is being overhauled to be followed by the tug Pilot Boy for drydocking and general repairs to the hull, scraping and painting. As the southern yachting season is soon to open the company expects a number of steam and gas yachts from the north for overhauling, thus providing steady work for their full normal force. The company also expects to expand in the construction of small pleasure sail boats.

New Steamers Contemplated, Baltimore, Md.—That the construction of new steamers is contemplated by the Merchants and Miners Transportation Company, is one of the newest developments indicating improvement in the shipbuilding industry, according to official information obtained by Marine Engineering and Shipping Age. Advices received from A. D. Stebbins, president and general manager of the transportation company, state that the line will "undoubtedly have to build some steamers in the near future," although no definite plan has been determined upon as yet.

Robins Yard Gets "American Legion," Brooklyn, N. Y.—The Robins Dry Dock & Repair Company was awarded the contract for repairs to the United States Shipping Board steamer American Legion, bids for which were opened at 45 Broadway, New York, on Thursday, September 8. The tenders submitted were as follows: Robbins Dry Dock & Repair Company, $14,980; Standard Shipbuilding Corporation, $17,368; New York Harbor Dry Dock Company, $24,103; Morse Dry Dock & Repair Company, $25,500; W. & A. Fletcher Company, $30,080.

CONSTRUCTION FOR NAVY

Vessels under construction for United States Navy and their degree of completion as reported August 31, 1921, by the Bureau of Construction and Repair, Washington, D. C., are as follows:

Type Number and Name	Contractor	Per Cent. of Completion Sept. 1, 1921 Total
BATTLESHIPS (BB)		
44 California	Mare Island Navy Yard	Comm.
45 Colorado	New York S. B. Corpn.	78.4
47 Washington	New York S. B. Corpn.	69.3
48 West Virginia	Newport News S. B. & D. D. Co.	61.
49 South Dakota	New York Navy Yard	34.1
50 Indiana	New York Navy Yard	31.2
51 Montana	Mare Island Navy Yard	27.3
52 North Carolina	Norfolk Navy Yard	36.5
53 Iowa	Newport News S. B. & D. D. Co.	29.
54 Massachusetts	Beth. S. B. Corpn. (Fore River)	10.4
BATTLE CRUISERS (CC)		
1 Lexington	Beth. S. B. Corpn. (Fore River)	24.2
2 Constellation	Newport News S. B. & D. D. Co.	13.3
3 Saratoga	New York S. B. Corpn.	27.4
4 Ranger	Newport News S. B. & D. D. Co.	2.5
5 Constitution	Philadelphia Navy Yard	10.7
6 United States	Philadelphia Navy Yard	10.4
SCOUT CRUISERS (LIGHT CRUISERS CL)		
4 Omaha	Todd D. D. & Const. Corpn.	94.6
5 Milwaukee	Todd D. D. & Const. Corpn.	92.4
6 Cincinnati	Todd D. D. & Const. Corpn.	87.1
7 Raleigh	Beth. S. B. Corpn. (Fore River)	63.7
8 Detroit	Beth. S. B. Corpn. (Fore River)	66.3
9 Richmond	Wm. Cramp & Sons Co.	70.
10 Concord	Wm. Cramp & Sons Co.	66.
11 Trenton	Wm. Cramp & Sons Co.	50.
12 Marblehead	Wm. Cramp & Sons Co.	46.
13 Memphis	Wm. Cramp & Sons Co.	40.
AUXILIARIES		
Fuel Ship No. 18, Pecos (Oiler A06)	Boston Navy Yard	Comm.
Repair Ship No. 1, Medusa (AR1)	Puget Sound Navy Yard	68.
Dest. Tender No. 3, Dobbin (AD3)	Philadelphia Navy Yard	66.3
Dest. Tender No. 3, Whitney (AD4)	Boston Navy Yard	32.8
Sub. Tender No. 3, Holland (AS3)	Puget Sound Navy Yard	21.5
Aircraft Tender, Wright (AZ1)	Tietjen & Lang	90.
PATROL VESSELS		
Gunboat No. 22, Tulsa (PG22)	Charleston Navy Yard	70.6

Authorized but not under construction or contract.
(1) Transport No. 2.

DESTROYERS		
338 Wasmuth	Mare Island Navy Yord	99.2
339 Trever	Mare Island Navy Yard	97.3
340 Perry	Mare Island Navy Yard	71.6
341 Decatur	Mare Island Navy Yard	65.4

Destroyers authorized but not under construction or contract.
(12) Nos. 348 to 359 inclusive.

SUBMARINES		
115 S-10	Portsmouth, N. H., Navy Yard	93.6
116 S-11	Portsmouth, N. H., Navy Yard	91.1
117 S-12	Portsmouth, N. H., Navy Yard	89.3
118 S-13	Portsmouth, N. H., Navy Yard	86.6
123 S-18	Electric Boat Co. (Quincy)	97.
124 S-19	Electric Boat Co. (Quincy)	96.5
125 S-20	Electric Boat Co. (Quincy)	98.5
126 S-21	Electric Boat Co. (Quincy)	94.9
127 S-22	Electric Boat Co. (Quincy)	95.8
128 S-23	Electric Boat Co. (Quincy)	94.
129 S-24	Electric Boat Co. (Quincy)	93.
130 S-25	Electric Boat Co. (Quincy)	93.5
131 S-26	Electric Boat Co. (Quincy)	92.4
132 S-27	Electric Boat Co. (Quincy)	91.
133 S-28	Electric Boat Co. (Quincy)	91.6
134 S-29	Electric Boat Co. (Quincy)	90.5
136 S-31	Electric Boat Co. (San Fran.)	97.5
137 S-32	Electric Boat Co. (San Fran.)	95.9
138 S-33	Electric Boat Co. (San Fran.)	99.2
139 S-34	Electric Boat Co. (San Fran.)	95.2
140 S-35	Electric Boat Co. (San Fran.)	92.5
141 S-36	Electric Boat Co. (San Fran.)	89.2
142 S-37	Electric Boat Co. (San Fran.)	86.6
143 S-38	Electric Boat Co. (San Fran.)	80.
144 S-39	Electric Boat Co. (San Fran.)	75.1
145 S-40	Electric Boat Co. (San Fran.)	74.6
146 S-41	Electric Boat Co. (San Fran.)	77.8
153 S-42	Electric Boat Co. (Quincy)	72.6
154 S-43	Electric Boat Co. (Quincy)	73.1
155 S-44	Electric Boat Co. (Quincy)	71.1
156 S-45	Electric Boat Co. (Quincy)	71.8
157 S-46	Electric Boat Co. (Quincy)	70.3
158 S-47	Electric Boat Co. (Quincy)	69.7
159 S-48	Lake T. B. Co. (Bridgeport)	96.2
160 S-49	Lake T. B. Co. (Bridgeport)	92.2
161 S-50	Lake T. B. Co. (Bridgeport)	89.4
162 S-51	Lake T. B. Co. (Bridgeport)	84.6
FLEET SUBMARINES		
60 T-2 (SF 2)	Electric Boat Co. (Quincy)	99.3
163 V-1 (SF 4)	Portsmouth, N. H., Navy Yard	3.7
164 V-2 (SF 5)	Portsmouth, N. H., Navy Yard	3.7
165 V-3 (SF 6)	Portsmouth, N. H., Navy Yard	3.7

Note: Submarines authorized but not under construction or contract.

Fleet submarines (6) Nos. 166 to 171.
Neff submarine (1) No. 108.

To Recondition Steamer, New York.—Tenders for reconditioning the steamship Olympe, the specifications covering two separate items, one for the installation of a new 'tween deck and another for watertight bulkheads and general overhauling, were opened on August 24, at the office of Cozins & Petrie, marine engineers, 42 Broadway, New York. The figures submitted have been forwarded to the owners in France and a decision on the awarding of the contract is expected in the near future. The prices submitted are as follows: Standard Shipping Corporation (A) $62,955—35 days, (B) $57,874—33 days; Todd Shipyards Corporation (A) $71,230—30 days, (B) $67,100—30 days; Jas. Shewan & Son (A) $74,545—30 days, (B) $66,630—30 days; Morse Dry Dock & Repair Co. (A) $80,000—35 days, (B) $66,000—35 days; Ira Bushey & Son (A) $86,206—36 days, (B) $79,426—36 days; National Dry Dock Co. (A) $109,000—55 days, (B) $99,441—55 days.

Subchasers to be Converted into Yachts, Seattle, Wash.—H. K. Schell, naval architect, of Seattle, has prepared designs for the conversion of two submarine chasers into high speed pleasure yachts. One of the vessels, purchased from the Navy by G. H. Withy, of Vancouver, B. C., is undergoing alterations at the old Meacham & Babcock yard, Seattle, and the other bought by Los Angeles interests, at the plant of the Blanchard Boat Company, Lake Union, Wash. The original cost of the craft in each instance is estimated at close to $122,000, and their conversion will involve the expenditure of about $40,000 each. Alterations and repairs to the engines of both vessels are being undertaken by Messrs. McKechnie & Hamilton, experts on yachting engines and motors.

New Pleasure Yacht, San Francisco, Cal.—A new pleasure yacht to have Diesel electric drive is being constructed for G. Allan Hancock, millionaire oil magnate, of Los Angeles. The vessel is 132 feet long, 20 feet wide and 7 foot draft, with a straight stem and cruiser stern. She is to be finished throughout with hardwood and is to be a floating palace when completed, according to plans of the builder. The machinery installation consists of two six-cylinder Winton Diesel engines, each directly connected to a 90-kilowatt 125 volt direct current generator turning at 450 revolutions per minute. The main driving motor is a 215 shaft horsepower 250 volt double armature model, turning the propeller shaft at 275 revolutions per minute, and is expected to develop a speed of about nine or ten knots. The vessel will be heated and lighted by electricity, and all cooking is to be done by means of electricity as well.

Fletcher Company Contracts, Hoboken, N. J.—Contracts for dry docking and general overhauling and renewal of plates in the steamship Ed. V. Harkness, of the Standard Oil Company of New Jersey, and dry docking and general overhauling of the steamship Winamac, of the Standard Oil Company of New York, have been awarded to the W. & A. Fletcher Company. The total amount involved will be close to $10,000. The same company also has the steamship Acropolis, operated by Stephen D. Stephenitis, 24 State street, New York, for voyage repairs. The Shipping Board steamer Osakis was awarded to the Fletcher Company for the installation of a new tail shaft, dry docking, and considerable engine and bottom work at a price of approximately $3,000.

To Convert Bermuda Liner, Quincy, Mass.—The Bethlehem Shipbuilding Corporation, Fore River Yard, with a price of $44,000, was the low bidder for the steamship Fort St. George, of the Furness-Bermuda Line, to be converted from coal to oil burning, the bids for which were opened recently. Other bidders were: New York Harbor Dry Dock Company, $53,417; Standard Shipbuilding Corporation, $55,433; Robins Dry Dock & Repair Company, $68,823; Newport News Shipbuilding Company, $70,300; James Shewan & Sons, $77,500; Morse Dry Dock & Repair Company, $80,275; W. & A. Fletcher Company, $105,000.

Three Ships Needed, Seattle, Wash.—The possibility of three vessels for lines operating on the west coast is seen in the announcement from Seattle that plans are being considered by the Poulsbo Transportation Company for the purchase or construction of a steamer to replace the steamship Athlon, which went ashore near Point Ludlow, Puget Sound, recently; from the same place the Alaska Steamship Company is reported as investigating the field with a view of acquiring another vessel to replace the wrecked steamship Alaska, which went aground off the Oregon coast, and from the Gray's Harbor Dredging Company, of Aberdeen, Wash., that it will salvage the wrecked steamer Canadian Explorer, operated by the Canadian Government and valued at $500,000, which is lying off the Washington coast broken in two from having gone on the rocks.

PORT IMPROVEMENTS

Ship Canal, Chile.—The Government of Chile has under consideration the construction of a ship canal from Talcahuano to Concepcion.

Wharves, Mobile, Ala.—The City Commission is receiving bids on repairs to the bulkheads and wharves at the foot of Dauphin street, involving the expenditure of about $10,000.

Seawall, Barnegat, N. J.—The State Department of Commerce and Navigation, Trenton, N. J., plans to build a concrete seawall at Barnegat to cost about $25,000. For further information address R. F. Engle, Beach Haven, who is a member of the board.

Dredging, Filling, Etc., Sarasota, Fla.—A. B. Edwards, mayor, has let a contract to the Burns Dredging Company, to fill, dredge and bulkhead the harbor at Hog Creek.

Canal, Canada.—The Department of Railways and Canals, Parliament Building, Ottawa, Canada, has let a contract for building sections 1 and 2 of the Welland Ship Canal to J. P. Porter & Company, Pickford & Black's Wharf, Halifax, N. S. This work involves the expenditure of about $8,000,000.

Warehouse, Galveston, Tex.—The Galveston Wharf Company has awarded a contract to M. C. Bowden for the construction of additional cotton warehouse facilities to provide space for 90,000 bales.

Canal, Lake Charles, La.—The Calcasieu Parish Police Jury will construct a deep water canal to connect Lake Charles with the Sabine River and the Gulf of Mexico. A bond issue in the amount of $2,750,000 to cover the cost of this project will be voted upon November 8.

Dredging, Barnegat, N. J.—Victor Gelineau, Director, Board of Commerce and Navigation, State House, Trenton, N. J., will receive sealed proposals until 12 o'clock noon (daylight saving time) Tuesday, October 4, for dredging a section of the proposed inland waterway connecting Barnegat Bay with the Manasquan River, for which the sum of $50,000 is available. Further information may be obtained upon application.

Dock Equipment, Oakland, Cal.—Freight handling equipment, including loading and unloading machinery, hoisting equipment, etc., will be installed on the new dock to be constructed by the Board of City Commissioners, which is estimated to cost $100,000. Albert E. Carter, city commissioner, is in charge.

Dredging, Improving Pier, Jacksonville, Fla.—It is announced by the city commission that John Emil has been awarded the contract for dredging the slips at the Jacksonville terminal to 30 feet depth. Pier No. 2 is being improved and permanently prevented from settling by the driving of a number of piles to a depth of 45 feet upon the tops of which a retaining platform has been built.

Docks, Wharves, Etc., Norfolk, Va.—Charles E. Ashburner, manager, contemplates a bond issue for the development of the waterfront property, including the erection of a grain elevator of 1,000,000 bushels capacity, as well as docks, wharves and warehouses. This project is estimated to cost between $3,000,000 and $4,000,000.

Pier and Platform, New York.—Contract No. 1694.—Commissioner M. Hulburt, of the Department of Docks, Pier A, foot of Battery Place, North River, New York, has let a contract for building the pier and platforms on the outshore portion of Brooklyn Bridge improvement, Borough of Manhattan, to G. B. Spearin, Inc., 90 West street, New York, at a price of $322,236.

Canal, Etc., Columbia, S. C.—The Columbia Railway & Navigation Company, Columbia, S. C., has plans for the construction of a new hydroelectric generating plant on a canal to be constructed connecting the Santee and Cooper Rivers, with an initial capacity of about 30,000 horsepower. The entire project is estimated to involve the expenditure of about $5,000,000. G. A. Guignard is president of the company.

Extensive Harbor Improvements, San Diego, Cal.—According to a recent announcement harbor improvements calling for the expenditure of several hundred thousand dollars are to be made jointly by the Santa Fe Railway Company and the Spreckels

Brothers Commercial Company. The greater part of the money will be applied to the reconstruction of the east and west Santa Fe wharves and in other improvements to the railway company's deep-water terminal.

To Start Work on Pier, Hoquiam, Wash.—The Grays Harbor Port Commission received bids September 13 for all pile driving and timber construction on the first unit of pier No. 1 at Cow Point. The work includes the furnishing of all material and labor in the construction of 167,000 square feet of pile and timber wharf, or approximately 195,000 linear feet of piles, 2,905 pieces; 1,974,000 f. b. m. lumber and 84,000 pounds of iron.

To Buy Harbor Site, Norfolk, Va.—Three possible sites for the location of a small boat harbor were offered to the Port Commission. These parcels of land are the Norfolk Warehouse Corporation's property on Front street, Atlantic City, the Old Dominion Terminal property which belongs to the Homes Corporation, lying between the Norfolk and Western piers and Tarrant's Creek, and the property at Tarrant's Creek belonging to Robert D. Davis and others. All three properties will be appraised by a board of appraisers, to be appointed within a few days, and their results reported to the Port Commission at a later meeting.

New Pier Probable, Hoboken, N. J.—The construction of a new large concrete pier, fitted with modern equipment, to replace the waterfront property at the U. S. Army base, destroyed by fire on August 25 and 26, was considered very probable in marine circles today. As a result of the fire, Pier 5 was totally destroyed; pier 6 was estimated as a 25 percent loss; and two buildings were totally burned. No authentic figures on the extent of the damage could be obtained, although it was stated a board of officers is conducting an investigation. According to information obtained by Marine Engineering and Shipping Age, the Government has for some time past considered the advisability of erecting a new concrete pier at this point, and it is believed the burning of the old piers will facilitate the carrying out of previous plans.

$10,000,000 Port for Newark, N. J.—It is announced that the city of Newark will spend $10,000,000 on a port terminal which is intended to convert the west shore of Newark Bay into an ocean port capable of docking the largest cargo and passenger steamers. The port's chief asset is its facilities for transferring freight direct from railroad to water carrier. The city has already spent $4,400,000 on the bay front development, including current contracts, and there is an additional appropriation of some $400,000 available now for a portion of the new work contemplated. It is the policy of the city government to expend in the neighborhood of some $5,000,000 more eventually on piers, warehouses, a city-owned railroad, classification yard, more highways leading through the mass of industrial sites in the port area and other improvements.

May Spend Millions in New York Harbor.—The Edge-Ansorge Bill for harbor development was signed on August 23, by President Harding, thus assuring cooperative effort between the Federal Government and the States of New York and New Jersey to insure the proper development of New York harbor as proposed by the Joint Commission of New York and New Jersey in the treaty entered into by the two States on April 30, 1921, for the purpose of relieving congestion in the harbor. Tentative plans contemplate the construction of an automatic electric system with joint terminal stations for the expeditious distribution of food-stuffs and other merchandise. Other improvements proposed include the establishment of free ports, construction of wider piers and more warehouse facilities at the congested points, the dredging of channels to every part of the port's waterfront, the development of a belt line railroad system around the port, erection of grain elevators, construction of additional terminals for the New York Barge Canal and the construction of highway access to every part of the port's waterfront. The fulfilment of these plans will relieve congestion and expedite and cheapen the distribution of foodstuffs and materials in and through the entire port district and to points throughout the country.

GOVERNMENT WORK

Operating Building, Port Arthur, Tex.—Specifications 4511. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct an operating building at Port Arthur.

Boiler Plant Improvements, Annapolis, Md.—Specification 4500. The Bureau of Yards and Docks, Navy Department, Washington, D. C., will soon receive bids for boiler plant improvements at the Naval hospital.

Heating System, Etc., Norfolk, Va.—Specification 4512. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to alter and build an addition to the underground heating and drainage systems for the electrical distributing system at Norfolk.

Refrigerator Equipment, Newport, R. I.—Specification 4499. The Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids for the installation of refrigerating equipment.

Boiler Plant Equipment, San Diego, Cal.—Specification 4494. The Bureau of Yards and Docks, Navy Department, Washington, D. C., will soon receive bids for boiler plant equipment to be installed at San Diego.

Dredging, New Haven, Conn.—The United States Engineer, Providence, R. I., has let a contract for dredging in New Haven Harbor, to the J. S. Packard Dredging Company, 104 Turks Head Building, Providence. This work involves the expenditure of about $40,000.

Dredging, New Jersey.—The United States Engineer, 2nd District, Room 616, Army Building, New York City, has let contracts for dredging in the Shrewsbury River and Keyport Harbor, N. J., to J. P. Randerson, 51 State street, Albany, N. Y., and the Taylor Dredging Company, Communipaw avenue, Jersey City, N. J., the contracts amounting to $14,900 and $11,225, respectively.

NEW INCORPORATIONS

The Montreal Boatbuilders, Ltd., Lachine, Quebec, Can., has been incorporated under the Dominion Companies Act with a capital of $100,000 to build, deal in and operate ships of every description, wharves, piers, docks, warehouses, etc. W. S. Johnson, A. R. Hall, E. M. Pierce, J. Edward and R. R. Larabee, Montreal, are the incorporators.

The North Shipping Company, Ltd., and the South Shipping Company, Ltd., with offices at Quebec, Que., Can., have been incorporated under the Dominion Companies Act with a capital of $500,000 each, to carry on a passenger, mail and freight transportation business, as well as towing and wrecking, etc., in any navigable water in and bordering on the Dominion, and to and from any foreign port. These companies are said to be subsidiaries of the Clark Steamship Company. A. C. and H. P. Hill, C. H. MacLaren, S. A. V. Martin, and L. Mattman, Ottawa, are the incorporators.

The H. W. Sweet Shipyard & Machine Works, Inc., Greenport, N. Y., was recently incorporated with a capital of $75,000 by H. W. Sweet, F. B. Corey and C. W. Thorn, to operate a shipbuilding plant and general machine construction and repair works.

FOREIGN ACTIVITIES

Ships for German Line.—It is reported that Messrs. Blohm & Voss, Hamburg, Germany, have been awarded a contract by the Hamburg-American Line to build three passenger steamers, each of 22,000 tons, and eight Diesel-engined vessels of 6,000 tons.

New Shipping Company Formed in Germany.—The Nordland Handels u. Schiffahrt, A. G., Hamburg, has been established with a capital of 100,000 marks to engage in shipping and allied business, particularly with Scandinavian countries. Herr Bergh, of Sweden, is director of the new concern.

To Convert Yacht, Germany.—The steam yacht Lensahm, formerly owned by the Archduke von Oldenburg, was recently sold to the firm of Wilhelm Börstler & Company, Hamburg. The vessel will be converted for commercial service, and has been sent to the Frankesche Werft at Reiherstieg.

Danish Shipping.—According to reports from Copenhagen, there has been a decided improvement in Danish shipping since the settlement of the coal strike in England. During the last six weeks 8,000 tons of shipping that had been laid up have again come into operation, out of a total of 283,000 tons, or 107 ships.

New Ship Service by Norwegian Firm.—The North and South Atlantic Line of Bergen will shortly open a new service between New Orleans and the principal ports of Mexico in competition with American ships. Vessels of 2,400 tons will be placed on this route.

To Improve Port, Russia.—It is reported that the port of Reval is being extensively enlarged and that all modern improvements will be introduced in order to facilitate trade with Russia.

New Dry Dock, Holland.—The Amsterdam Dry Dock Company is said to have placed an order recently with the Netherlands Shipbuilding Company of Amsterdam for its fifth floating dry dock which will be the largest in the Amsterdam harbor. It will be capable of lifting 25,000 tons; will be 650 feet in length, electrically lighted and driven, and provided with compressed air apparatus.

London to Have Ship Repair Yard.—When the firm of Harland & Wolff takes over, in addition to its present yards at Belfast, Govan and Greenock, by the authority of the port of London, all the port maintenance work and a large proportion of the engineering and repairing staffs, numbering 1,000, thus extending the Thames side of its works, London will have ample facilities for repairing the largest transatlantic liners which previously were not able to berth at this port. The company plans to provide extensive workshops, both afloat and ashore, to cost more than a quarter of a million dollars, as a sequel to the inauguration last July of a new drydock capable of accommodating most of the biggest liners.

Mauretania to Be Oil Burner, Wallsend.—It is announced that Swan, Hunter & Wigham Richardson, Ltd., Wallsend on Tyne, builders of the Mauretania, has received a contract from the Cunard Line to convert this vessel into an oil burner, at the same time making repairs necessitated by the recent fire on board the vessel. The job is estimated to take about six or seven months. This will make a total of six vessels using oil fuel in the combined fleet of the Cunard-Anchor Lines. All of the new fleet of eighteen vessels ordered since November, 1918, will also be oil fueled.

British Resume Shipbuilding Work—It is announced that on September 25 the Government dockyards resumed building activities on full time. The Cunard Company has also ordered resumption of work on three of the five vessels being built for the company on the Tyne, two of which ships have already been launched. The Cunard Line is building ten vessels for the transatlantic trade.

Activity at Palmer Yards, England.—During the last nine weeks there were five vessels launched from the several yards of the Palmer Shipbuilding Company at Jarrow, Amble and Hebburn, the most recent launching being that of the 10,000-ton passenger and freight steamer Meriones for the Ocean Steamship Company of Liverpool, from the yard at Hebburn. A 500-ton steel tank barge for the Buenos Aires station of the Anglo-American Petroleum Company was launched from the ways of the Amble yard. The company is said to have a good deal of work on hand and is making steady progress toward the completion of a variety of vessels.

River Boat Building for Roumania.—According to recent reports, there seems to be an opportunity in Roumania for the employment of many more river craft. Although on account of present economic conditions it may be difficult to sell such boats to Roumanian purchasers, arrangements might be made to extend credit on terms, or to take an interest in navigation companies to be formed for the purpose of supplying some of the deficiency in transport.

New Steamship Service, Spain—It is announced that a new steamship service between Santander and New Orleans, calling at Havana and Vera Cruz, has been established, the first vessel sailing from Santander in September.

Welland Canal Contract—J. P. Porter, Halifax, N. S., was awarded the contract for sections 1 and 2 of the new Welland Canal, comprising the work between Lake Erie and Lake Ontario, a distance of seven miles, the cost of which is estimated at $8,000,000. Contracts for sections 3 and 4 will soon be awarded by the Department of Railways and Canals, and work on section 5 is already being done under contract. With the completion of this work the canal, which is to consist of seven locks, will be able to accommodate vessels of 14 feet draft, and when the portion of the canal from the end of section 5 into Lake Erie has been deepened, vessels of 12,000 tons will be able to pass from Port Arthur to Kingston, at the foot of Lake Ontario.

BUSINESS NOTES

The Babcock & Wilcox Company, 85 Liberty Street, New York, manufacturers of water-tube boilers for land and marine service, has opeend a marine office in the Guardian Building, Cleveland, Ohio, and will be represented by Mr. John Coleman, who has been connected with the Babcock & Wilcox Company for over twenty years.

The Engineer Company, 17 Battery Place, New York, has secured the exclusive rights for the manufacture and sale of the improved standard navy burner (Starr patent) and the air register (Purnell patent) developed by Lieutenant-Commander Purnell, who was recently in charge of the United States Navy Fuel Oil Testing Plant at the League Island Navy Yard, Philadelphia, Pa. These products will be marketed under the commercial names of "Enco" burner and "Enco" register.

The Thacher Propeller & Foundry Corporation announce the engagement by them of Mr. F. V. Archer, formerly manager of Naumburg & Company, New York, Boston, Philadelphia, etc., who has assumed the duties of vice-president in charge of finance, cost, expenditures, etc. Mr. Archer is particularly well experienced in the qualifications necessary to his new duties, having had charge of analysis and finance for some of the largest American industries. He assumed his new duties September 1, with headquarters at the main office in Albany, N. Y.

It is announced that Lykes Brothers, Inc., one of the largest operators of United States Shipping Board vessels in this country, have opened a steamship office in Tampa, Fla., as they propose to operate vessels in the phosphate trade from Tampa.

The Goetze Gasket & Packing Company, New Brunswick, N. J., announces the opening of a branch office at Philadelphia, Pa., in the Drexel Building, 5th and Chestnut streets, under the management of the Sheffler-Gross Company.

Contract for Navy Cranes

The Navy Department has awarded a contract to The McMyler-Interstate Company for two 50-ton dry dock cranes, one crane to be erected on the dry dock at South Boston and one on the new dry dock at Puget Sound Navy Yard at Bremerton, State of Washington.

The amount of the contract for the two cranes is about $310,000. The crane for South Boston is to be completed in 250 days and the crane for Puget Sound is to be completed in 280 days. The cranes will be steam operated and will travel on rails having a gage of about 22 feet, with 16 wheels on each side. The cranes are of the traveling, revolving type with a movable jib or boom. They have a capacity of 50-gross tons at a maximum radius of 90 feet 6 inches on the main hoist and a capacity of 15 gross tons at a maximum radius of 129 feet 6 inches on the auxiliary hoist.

TRADE PUBLICATIONS

Lighting Data.—Pamphlets containing information on reflectors for incandescent lamps and ship lighting have been compiled by A. B. Oday and A. S. Turner, Jr., of the lighting service department, Edison Lamp Works, General Electric Company, Harrison, N. J. The paper on reflectors gives a general discussion of their use, materials, types, efficiencies and also contains data sheets of the characteristics of each type. The pamphlet on ship lighting states the requirements to be met for wiring and fixtures and gives illustrated examples of lighting in various sections of the ship.

Metal Spraying Process.—The process for depositing a coating of metal on nearly all manner of materials known as the Schoop metal spraying process is outlined in a pamphlet issued by the Metals Coating Company of America, 495-497 North Third street, Philadelphia, Pa. The scientific development of this process, a description of the machines used and the range of application are fully described.

Condensers.—A general catalogue illustrating condensing equipment and auxiliaries has been sent out by the Wheeler Condenser and Engineering Company, Carteret, N. J. Equipment for both stationary and marine service are described. Special attention is called to a new design 26-inch vacuum surface condenser which dispenses with auxiliary pumps; the Wheeler steam jet air pump with combined inter-condenser and heater; the Wheeler jet condenser with expansion joint between condenser body and turbine.

New York Shipbuilding Corporation Record.—The record of ships built by the New York Shipbuilding Corporation, Camden, N. J., has been published and is now being distributed. "Craftsmanship, developed through years of steadfast adherence to the highest standards of character, is reflected in the performance of the ships built. Their service, the diversity of experience gained in the construction of every type vessel, and the firm foundation of sound shipbuilding methods and unequalled plant facilities of this great shipyard during the twenty-one years of its existence—passenger liners, tankers, colliers, superdreadnoughts, destroyers, general cargo vessels, river steamers, lightships, revenue cutters, fire boats—each type has contributed its share to the complete experience of the yard." From the earliest ships built to the latest battleship and passenger liner constructed, the work of the yard as given in this book is a wonderful example of accomplishment in American Shipbuilding.

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INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

ITALY

COLLEGIO DEGLI INGEGNERI NAVAL E MECCANICI IN ITALIA.
Via Carlo Alberto 18, Genova.

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WE GUARANTEE that of this issue 6,600 copies were printed; that of these 6,600 copies 4,167 were mailed to regular paid subscribers, 523 were provided for counter and news company sales, 269 were mailed to advertisers, 37 were mailed to employees and correspondents and 1,604 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 77,400—an average of 7,036 copies a month.

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Order Your Copy of the Annual Index Now

IN accordance with the practice established last year, the annual index of MARINE ENGINEERING AND SHIPPING AGE, which formerly was published as a part of the December issue, will be published separately at the end of the year. As the annual index will be useful only to those subscribers who have kept a complete file of the magazine for the year only a sufficient number of copies will be printed to fill the orders received for it at this office on or before December 1. A copy of the index will be mailed without cost to each subscriber whose order is received on or before that date.

The Butler Bill

IF the Butler Bill, now pending in the House of Representatives, which, as fully described on page 803 of this issue, provides for an efficient auxiliary naval reserve of mutual benefit to both the navy and the merchane marine, is being kept on the "waiting list" for the purpose of ascertaining the results of the disarmament conference before action, this is indeed a short-sighted policy. Whatever may be the decision in regard to the construction of warships it is the declared purpose of the United States as expressed in the preamble of the Jones Act to do whatever may be necessary to develop a merchant marine adequate in size to carry our share of our commerce and to serve as a naval or military auxiliary in time of emergency.

In spite of this declared purpose it has been the policy of the Government to delay action of the constructive sort on any legislation, or, for that matter, to enforce the laws that would benefit our merchant marine. Instead of holding up the hearings on this bill it ought to be apparent to any one much less informed than the Naval Committee of the House of Representatives that if it is decided to weaken our regular Navy it is even more important to provide for an efficient naval reserve.

Other countries have long ago recognized the necessity of having their merchant ships manned by a majority of their own nationals who are fully trained to serve their country in time of war. There is no better way than that which the Butler Bill provides to secure all-American crews for our ships and at the same time equalize the disparity existing between the wages of foreign and American seamen. The merit of this bill is recognized by both naval and shipping authorities, but of what value will it be if its passage is delayed until our vessels are tied up? We need action on this bill, and quickly, too, for the cheaper cost of operation of foreign ships is driving our vessels off the seas.

The Scythia

BECAUSE there is a surplus of cargo ships for the present condition of world trade, causing the tying up of a large number of this class of vessels, the United States is losing sight of the fact that there is a world shortage of 2,000,000 tons of passenger ships. This figure was given in a paper read last winter before one of England's leading technical marine societies and also at the launching of the *Empress of Canada*. The demand that exists for the remaining combination passenger and cargo vessels building for the Shipping Board also corroborates this statement and the fact that the Board continues to certify to the Interstate Commerce Commission that there are not sufficient American vessels to warrant the enforcement of the preferential rail rates proves that our surplus of tonnage does not include passenger ships. If America displayed half the broad foresight in dealing with its merchant marine that it does with its other industries it would not only expedite the reconditioning of the *Leviathan* and the other ex-German passenger vessels, but it would also have well under construction new liners of the most up-to-date type, which are needed to balance our merchant marine.

This is exactly what England is doing, as many of her large shipping companies are proceeding with an active building program of liner construction. The *Scythia,* fully described on page 819 of this issue, represents the Cunard Line's latest type of post-war construction. Although not as large as the *Aquitania* and *Mauretania* she has the advantage of combining large cargo carrying capacity with luxurious passenger accommodations.

Whether or not the Cunard Line has taken the wisest policy in adopting the intermediate size of passenger ship exclusively in her present building program of a dozen vessels the fact remains that it will have a large fleet of new boats before we have even reconditioned our own. Is it not about time to help the unemployment situation and, incidentally, benefit the country by getting our most useful type of boats into commission? The repair yards are ready; the ex-German liners are not getting any younger and the time is not so far distant when it will be too late to renew them into the type of first-class vessels that they were intended to be. Even if we have lost our nerve entirely and have no stomach for entering into competition with foreign shipping companies in the passenger business, why not put these ships into shape and sell them to whatever country wants them rather than allow them to rot at their piers as they are now doing?

Discrimination

ALTHOUGH it is clearly recognized by both the shipping and shipbuilding interests that if the United States is to have an adequate merchant marine some form of Government assistance must be obtained, there is an honest difference of opinion as to whether this aid should be in the form of discriminatory duties or a direct subsidy. Either one of these methods would promote the construction of ships in American shipyards and also the sale of Shipping Board vessels to private owners. The principal objections to the direct subsidy are the difficulty of getting Congress to award such aid from the public treasury and the uncertainty from year to year of renewal. On the other hand the indirect subsidy or discriminatory duties, tonnage dues and preferential rail rates are certain to cause more or less friction for the steamship lines in transacting their business in foreign countries and, furthermore, their enforcement will necessitate the modification of existing treaties.

Although the President is directed by the Merchant Marine Act of 1920 to serve notice on such foreign governments as have treaties with us guaranteeing their ships the same or equal privileges to those that we grant our own, that such portions of these treaties as restrict the power of the United States to levy discriminatory duties and tonnage dues shall terminate at the expiration of the notice required in the respective treaties, President Wilson refused to obey this mandate of Congress and President Harding up to the present time has also evaded it.

No doubt the failure of our executives to follow the directions so plainly stated by Congress is largely due to the seriousness of disturbing existing treaties. But in neglecting this duty—for as we see it the President is bound to obey the law just the same as anyone else—both ex-President Wilson and President Harding have allowed the impression to grow in foreign countries that we are afraid to enforce these features of the Jones Act and, consequently, that they are free to inaugurate such discriminatory practices against our shipping as are not specifically prohibited by their treaties.

We are informed that the British Board of Trade has issued an order giving preferential treatment to British and Canadian vessels at the port of Jamaica. As the treaty of 1815 specifically excludes the West Indies from reciprocal privileges they have the legal right to do this but, in doing so, they have shown that they do not consider that the principle of preferential treatment is wrong.

For the benefit of those of our readers who did not closely follow the arguments presented during the passage of the Jones Act, it may be interesting to know that the powers of discrimination specified in that Act were supported by a number of Congressmen quite as much for the purpose of having a means of retaliation against the unfair shipping practices of foreign nations as for a method of equalizing the cost of operation of foreign and American shipping. Now that we have the examples of the Egyptian cotton contracts going to British ships in spite of our lower bids, the lower insurance rates on British vessels and the Jamaica order, there does not seem to be any legitimate objections why we should not enforce the Jones Act unless it be that we are losing our nerve and that we had rather "turn the other cheek" even if by so doing we have to tie up our entire fleet and acknowledge that the nation that once carried 90 percent of its commerce in its own ships must depend on foreign ocean delivery wagons to ship its products.

Foreign Trade and Shipping

CHAIRMAN LASKER of the Shipping Board in a recent speech before the Associated Advertising Clubs of the World laid down a great truth when he said that "the farmer in Kansas, the miner in Arizona and the industrial worker in Indiana" are just as much dependent upon the American merchant marine as "the dock worker in Baltimore or San Francisco for the regularity and volume of their daily wage." So long as we had a great empire to explore and develop there was not the need that now exists for foreign trade and we could live unto ourselves as a practically self-sustaining nation.

But now that surplusages have accumulated, unemployment has increased and prices of raw products have been demoralized. Until this excess has been consumed either at home or abroad, unemployment will continue and our surplus wealth, if not disposed of, will do us more actual harm than if we gave it away to the countries which need it so badly.

The whole world is looking to us for aid in this terrible time of industrial chaos for we have established a reputation for fair dealing and our duty as a civilized nation demands that we exert every influence to help stabilize the conditions in those countries where the political and financial situations are such that they are a menace to the welfare of the rest of the world. But insofar as we export our surplus products to the countries that need them we are also exporting the labor of the farmer in Kansas, the miner in Arizona and

the industrial worker in Indiana and in so doing we are preventing a costly reduction in our production output and the consequent lowering of the American standard of living. But, as Chairman Lasker stated, only a national realization of the fact that whatever our business may be our continuous employment and prosperity depend on foreign trade and our merchant marine will assure for our ships the financial and legislative aid that they are entitled to receive.

The Panama Canal Tolls

THE action of the Senate, which is unquestionably the more conservative of the two branches of our national legislature, in passing the Borah Bill by a vote of 47 to 37 which restores free tolls to American vessels engaged in the coastwise trade, is not only significant as a pointer on the probable action on this bill in the House of Representatives but also as an indication of the honest opinion of our most able statesmen that we have the right to allow at least some of our vessels the privilege of passing through our own canal free of charge.

At the time the Borah Bill was introduced there were other bills before the Senate which exempted all American vessels from the payment of Panama Canal tolls. The supporters of these bills, however, felt that the Borah Bill had the greatest chance of success and agreed to give it their support and the right of way. It was and is still the opinion of many in shipping circles that the passage of the Borah Bill is more a test of legislative and public opinion on the Panama Canal toll question as applied to all American ships than of especial value to either our merchant marine or the country as a whole. In support of this statement are the facts that American ships have a monopoly of the coastwise trade guaranteed to them by law, that the amount involved in the exemption of these tolls amounts to only about $2,000,000 annually and that this law except in certain cases, one of which we will comment on later, simply favors coastwise shipping at the expense of the railroads which are taxed along with other industries for the payments of money spent in the construction of the canal.

One of the exceptions referred to above may be illustrated by the case of two shipments to the port of New York, one coming from Vancouver, B. C., and the other from Seattle. It is evident from the proximity of Seattle and Vancouver that this comparison is all the more applicable because these cargoes may be identical in nature and therefore that a decided advantage in the carriage of the same products is given to the American vessels. Other cases may be cited but this is sufficient to show that, if it is right to give the trade from Seattle in American vessels an advantage over the trade from Vancouver in foreign vessels, it is also just as proper to give the same advantage to all American ships going through the Panama Canal from or to any port in any country.

Unfortunately there is difference of opinion on this question in this country among our most prominent men whose integrity, ability and patriotism cannot be questioned. As stated by Mr. Marvin on page 800 of this issue, it does not appear that where such able men disagree on the interpretation of the Hay-Pauncefote treaty it would serve any useful purpose for us to argue the technical points involved. But if our able statesmen disagree on the favors that we are privileged under the above-mentioned treaty to give to American vessels passing through an American Canal, they are at least in accord with the principle that we *should have the right* to exempt American vessels from the payment of these tolls, if we so desire.

The status of this question at the present time, as indicated by the recent vote in the Senate, is that the majority of our statesmen believe that we have the right to exempt our vessels from the payment of tolls and that the minority believe that we have lost this right through the superior diplomacy of British statesmen. A treaty is a solemn agreement between two or more nations and its supreme purpose is to make it possible for the countries involved to live in peace with each other. Often privileges are granted to other countries for reciprocal benefits.

But our English contemporaries do not point out why the rights *that they claim* we signed away were surrendered. We should like to know what the United States got in return, if it gave up these rights, for it is not conceivable that we would construct and maintain a canal on our own soil for the benefit of foreign merchant marines.

The I. M. M. Hearing

ALTHOUGH many statements and inferences have been made to the effect that the International Mercantile Marine Company is dominated by British interests, the public hearing given to that organization by the Shipping Board on October 5 disclosed no evidence of any attempt by the British Government or steamship interests to interfere in any way with the management of the American company. On the contrary, it was found that the agreements entered into between the British Board of Trade and the International Mercantile Marine Company were in every instance secured through the solicitation of the American company for the purpose of obtaining the same privileges for their ships, which are under the British registry, that are accorded to English owned vessels.

Chairman Lasker, the full Shipping Board and the Board's chief councillor, Mr. Schlesinger, conducted the examination which lasted from ten o'clock in the morning with the exception of an hour's recess until six o'clock in the evening. After a short explanation of the nature of the meeting by Chairman Lasker, the entire time was taken up in listening to an exhaustive explanation of the history, management and ownership of the International Mercantile Marine Company by its president, Mr. P. A. S. Franklin, and in questioning him on every relevant and sometimes irrelevant point that the entire Board or its Council could conceive.

While the investigation was carried on in a friendly spirit and, as explained by Chairman Lasker, with the principal purpose of determining the potentiality of the power of the International Mercantile Marine Company to adversely influence American shipping, nevertheless it must have been a trying ordeal to Mr. Franklin and it is greatly to his credit that he answered every question frankly and directly without any apparent attempt at evasion.

As to the ownership of the International Mercantile Ma-

rine Corporation, it was stated that the stock books as of August 1, 1921, show that 93½ percent of its stock is owned by American citizens, 5½ percent by Dutch, ½ of 1 percent by English and ½ of 1 percent by Canadians. Not only was a table of the number of preferred and common shares held in the different countries furnished but the Board was invited to appoint a committee of its members to examine the books and make any notes that it wished as to the individual holdings of any of the stockholders. All that was asked was that this information should be kept confidential by the Shipping Board.

Having established the ownership of the American company, it was declared that when the International Mercantile Marine Company took over the White Star Line, the International Navigation Company, Limited, the Red Star Line, the Leyland Line and the Atlantic Transport Line, the English owners sold their holdings outright and that the American company holds all of the stock in the important subsidiary companies. In addition to this, the American company holds 68.5 percent of the stock in the Aberdeen Line, 22.2 percent in Shaw, Savill and Albion Company, Limited, 10.4 percent in the Holland America Line and 16.5 percent in the New York Shipbuilding Corporation.

Referring to the management it was stated that the company had its own offices in charge of its own salaried employees in the principal seaports of the United States and Canada with a large number of sub-agents reporting to these offices from all sections of the country. It was also declared that the company had offices in all the important capitals and business centers of Great Britain and Europe.

It was brought out that the several agreements between the British Government and the American company had been given publicity both at the time of their consummation and since and that they had been filed with the Shipping Board in March, 1917; in January, 1919; in November, 1919, and still further referred to in correspondence. The 1903 agreement was made because the British Government had entered into negotiations with the Cunard company to loan that line sufficient funds to construct the two gigantic express liners *Mauretania* and *Lusitania* and had granted them a subsidy of sufficient size to pay the interest on the money and amortize the loan. This agreement secured the same assistance and mail contracts for the ships owned by the American company that were granted to British-owned ships and while it provided that the ships flying the British flag could not be transferred to the American registry without the consent of the British Government our own laws at that time would not permit of such a transfer. Another clause, forbidding the adoption of an operating policy for these American-owned vessels, which would be detrimental to British shipping, has never been evoked and was never considered to apply to ships flying the American flag.

However, at the request of the Shipping Board, the ships under the American registry were specifically exempted from the provisions of the previous contracts by the agreement of 1921, which is couched in practically the same language as the resolutions adopted by the Board. Although, according to Mr. Franklin, who by the way made his entire testimony under oath, the British Government never interfered in any way with the management of the American company, this exemption was highly desirable to set at rest any doubts that might arise on the subject.

In view of the fact that the International Mercantile Marine Company has been criticized for a lack of interest in the American merchant marine in spite of the fact that it built, owned and operated practically the only American passenger vessels that were in the transatlantic trade prior to the war, it is only just to state what this company has done to build up American shipping. It constructed at the Cramp shipyards in 1902 the *Kroonland* and *Finland* which it added to the fleet of four American ships that it then owned, namely the *New York, Philadelphia, St. Paul* and *St. Louis,* which composed the entire American flag passenger ships in the North Atlantic trade at that time. In 1915 it purchased the American steamers *Mongolia* and *Manchuria* and in 1917 the *Minnesota.* At the same time orders were placed with the New York Shipbuilding Company for the construction of two 12,000-ton freighters and one 6,000-ton freighter. In 1920 it transferred from the British flag to the American registry the *Minnekahda* of 17,200 gross tons and reconditioned her as a passenger steamer at a cost of $600,000.

Of still further interest is the fact that in 1918 it tried to dispose of its British ships to an English syndicate with the intention of reinvesting its money in American vessels but was prevented from doing this by the opposition of the American Government. Not discouraged at this, it has repeatedly endeavored to purchase the ex-German passenger ships, offering bids for the whole and various combinations of these vessels. One bid for thirty of these ships, including reconditioning, amounted to the sum of $78,500,000. Another bid, involving the *Leviathan* and *Mt. Vernon,* was particularly significant for it indicated a high class express passenger service for these ships on the New York-Southampton route.

This hearing was particularly valuable from several angles. It brought out the statement from Chairman Lasker that the Shipping Board was not in doubt as to the honesty and patriotism of Mr. Franklin and his company, but that they were concerned with the possibilities that a future management of the company might have the power through its English affiliations to injure American shipping. One of Chairman Lasker's questions was, would it be advisable to take into the Board's conferences with American companies owning American ships only a company like the International Mercantile Marine Company owning a large fleet of British ships? However, Chairman Lasker stated that it would be unfair to keep Mr. Franklin in doubt and that the Board would give its decision promptly.

Although it is most important to establish the status of the International Mercantile Marine Company in the minds of the American people, and we feel that the facts presented at this hearing ought to do it, the most important matter brought out, in our estimation, was a statement by Mr. Franklin which Marine Engineering and Shipping Age has repeatedly published and that is, that the world is not normally over tonnaged and that the useful tonnage of the world is not what it would have been if the war had not interfered with its natural growth.

Operating Economy and The Merchant Marine

By R. H. M. Robinson*

The problem of economical operation is one of supreme importance to American shipping. It is one which American shipowners must keep especially in mind during the next five years, for these years will surely see either the making or the unmaking of our merchant marine.

AMERICAN participation in overseas' shipping is virtually a development of the last half-decade. American overseas' operators have acquired their experience, therefore, during a period of abnormally high freight rates, when large profits tended to lessen the incentive for economy and to foster extravagant habits. To a certain extent these habits have undergone correction during the past twelve months of depression, but any one who has studied the situation carefully knows that there is yet much to be done in this connection before American ships are able to engage in keen and sustained competition with foreign ships.

A great deal is being said these days about the need of Government assistance for the merchant marine. That such assistance is necessary, for a period at least, is generally admitted. The disadvantages peculiar to American registry —high wages accentuated by abnormal exchanges, the high initial cost of ships, strict navigation laws, etc.—are so great that until time and public opinion have had a chance to alter conditions, even the strictest economy on the part of the shipowners will not enable them to meet foreign competition. The Government must come forward with measures of direct or indirect assistance to help the shipowners surmount these difficulties, but the shipowners have the reciprocal duty of operating as economically as possible, so as to reduce the margin of disadvantage which the Government must offset.

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R. H. M. Robinson

Government Assistance Not a Gratuity

Whatever aid the Government may give to the merchant marine during its formative period should not be regarded as a gratuity but as a very worth-while national investment. Again, such aid should not be administered so as to encourage extravagance, but in such a way as to show clearly that it is a recognition of the faithful endeavor of the American shipowner, handicapped as he is, to establish a useful national institution.

The practice of economy in operating starts before the operations themselves are begun—it starts with the choice of the right ship for the trade. This involves a multitude of considerations, ranging from the more general questions of size, speed and fuel to the more technical ones of hull and machinery designs. To the layman a ship is a ship but the experienced mariner knows that out of a hundred different ships there is one better suited to the trade in question than all others. Americans, particularly, need to study this problem, because of their relative newness to many routes and because a large proportion of the present American fleet is of standard type ships, built to serve generally in an emergency rather than for a particular trade.

The economical advantages of the motorship, as compared with the steamship, are now established by experience in almost every trade. During the recent shipping depression, when hundreds of coal and oil burning steamers have been laid up, relatively little motor tonnage has been forced into idleness. The European countries are building motorships in large numbers. In the United States much less progress has been made in this direction and unless the situation is corrected we shall soon find that the nations which have low wages, low building costs, etc., are also operating large numbers of economical motorships, while we, with high building costs and high wages, are trying to compete with less economical steamships.

Assuming that the right ship is placed in a particular trade, there is yet great possibility of exercising economy in the matter of fuel. This item constitutes a very large percentage of the total operating expense, and carelessness with respect to purchase price or consumption may easily make the difference between a fair profit and a profitless voyage. Hearty cooperation from the ships' engineers is essential to this particular economy. Good results have been accomplished, notably by foreign companies, through holding out to the men the promise of a share in the savings effected through keeping the fuel consumption below a specified amount for a specified performance.

The engineers can also do much toward reducing expenses for machinery repairs; first, by taking good care of the machinery so as to obviate unnecessary damage; second, by making minor repairs which fall within their competence, rather than calling for outside assistance; third, by insisting on fair prices when repairs must be performed by local firms. Profiteering on repair work, especially in the less familiar

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foreign ports, is notorious and American ships have become known as easy and sometimes not unwilling victims of this kind of robbery.

American marine wages are higher than those of other countries. Under such circumstances one would expect the size of American crews to be kept down to the minimum consistent with efficiency, but this has not been the case. Under pressure of the present stringency the number of men carried on certain ships has been cut by 12 percent without infringing the navigation laws or the inspection regulations or in any way crippling the ships, showing that the former manning scales, which were in accordance with general American practice, were excessive. The fact that under certain foreign flags larger crews are carried is no justification for excessive crews on our own ships. Fewer skilled men are generally used on these foreign ships. Furthermore, it is entirely proper that the American shipowners should expect and receive, within reasonable limits, greater service from men who receive so much greater pay and have so much better living and working conditions on shipboard.

It is not the purpose of this brief article to discuss in detail the many economies in ship operation, which can and should be effected. The ones touched upon serve merely to illustrate the general statement that the American shipowner must adhere to the practice of economy in all its phases, if he is to become a permanent factor in world trade. And not only must the shipowner look to economy but he must have the consistent cooperation of the men on shipboard and at the terminals. Such cooperation is essential to successful operation in any industry, and especially in shipping.

The Senate Vote for Panama Canal Toll Exemption

Republican National Platform Upheld By Senate in Passing Borah Bill—Exemption of Coastwise Shipping Approved by Decisive Vote

By Winthrop L. Marvin*

MUCH oratorical thunder and lightning accompanied the passage through the Senate, October 10, of the Borah bill exempting American coastwise ships from the payment of tolls in the Panama Canal. President Harding in his pre-election speeches had stoutly advocated this policy. The Republican National platform on which he won his victory had declared for it. It is assumed that, when the President gives the word that the course is clear, the measure will be approved by the House of Representatives. Meanwhile, throughout the country there will be sharp discussion pro and con—for famous names are marshalled on both sides. For example, exemption has been supported by Olney, Roosevelt, Knox and Taft and opposed by Root, Choate and Wilson. On the whole the people of the nation, or a majority of them, appear to agree with the former view, as the decisive vote in the Senate has just demonstrated.

As Senator Ransdell of Louisiana told the Senate in the course of the debate, a canvass of certain representative elements of the country on this Panama Canal issue was undertaken a few weeks ago on behalf of the National Rivers and Harbors Congress. This association in a questionnaire appealed not only to its own officers and members living in the East, the South and the Middle West, but also to governors of States, mayors of cities, chambers of commerce and boards of trade, public libraries and the editors of daily and weekly newspapers. On the question presented in the Borah bill, of exemption from tolls of American ships engaged in coastwise trade, the voice of this highly intelligent constituency was 520 in favor and 158 against—or an affirmative of more than three to one. There is, therefore, reason to believe that an even more decisive majority than the Senate gave will be recorded when the Borah bill comes up in the House of Representatives.

Senate Debate Deliberate and Comprehensive

It is to the credit of the Senate that its discussion of the tolls exemption question was deliberate and comprehensive. A chief argument of the opposition was that the bill affronted Great Britain on the eve of the opening of the world disarmament conference. How far this plea may have counted as a factor in the final vote must be a matter of conjecture. But it is noteworthy that toward the end of the discussion Senator Lodge, the Republican leader in the Senate, put himself on record as believing that we had the legal right to pass American vessels through the Canal toll free, if we so determined, subject to arbitration which could be invoked under our general treaties with Great Britain.

But he announced that he would oppose exemption of coastwise ships exactly as he had done in 1912 and 1914, on the ground that the interest of foreign nations was unitedly against us on the issue, while public opinion was divided in the United States. And he pointed to the differing views of ex-President Roosevelt and ex-President Taft on the one hand and of ex-Secretary Root and ex-Ambassador Choate on the other. Senator McCormick of Illinois as a spokesman for the Middle West declared that he held that the United States had the right to do what the bill proposed, but held also that it was "unwise to do it on the eve of the conference on the limitation of armaments."

Coastwise Vessels Pay $1,500,000 Tolls Annually

Tolls are paid in the Panama Canal "at $1.20 per net vessel ton—each one hundred cubic feet of actual earning capacity." The tonnage in this case is determined by Panama Canal rules and not by the United States National rules of measurement. American coastwise vessels eastward bound and westward bound are now paying tolls at a rate of about $1,500,000 a year. Their tonnage and payments of late have been steadily increasing. Exemption of coastwise ships was warmly attacked in the Senate debate as a "subsidy to a monopoly."

It is true that American ships have a monopoly of coastwise traffic through the Panama Canal, as they do on the Great Lakes and in the trade from New York to Galveston and from Puget Sound to San Francisco. If this is a monopoly, it is a beneficent one. No political party or faction has the hardihood to attack it, for it was this coastwise law that gave the United States the technical skill and experience in shipbuilding and operation that made possible the creation of the immense war-built fleet in the world war emergency. It is the coastwise law that was responsible, in 1914, for the existence of seven-eighths of the American merchant marine.

Is Toll Exemption a Subsidy?

But is exemption a subsidy to these coastwise ships? The late George S. Dearborn, founder and president of the American-Hawaiian Steamship Company and a pioneer in

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steam navigation from coast to coast, did not so regard it. In a letter addressed to Senator O'Gorman, then chairman of the Committee on Interoceanic Canals, Mr. Dearborn in April, 1914, said:

"The American-Hawaiian Steamship Company has never contributed to a toll exemption propaganda nor made any effort to influence opinion upon the subject. A toll would be an operating expense, added to other expenses such as fuel, victualing, manning and upkeep, and, to its extent, would increase the cost of transporting a ton of freight, and this increase would necessarily be reflected in the rate of freight. The implication that the cost of fuel, crews, insurance and upkeep affects the rate of freight and that the addition of a toll does not is too fallacious to require answer."

Mr. Dearborn, out of his practical experience, manifestly believed that the enforcement of or exemption from tolls would directly affect the freight rates through the Canal, and that in the long run it was the shippers of merchandise who would pay the tolls or would enjoy the direct benefit of no tolls. This opinion is also the opinion of chambers of commerce and boards of trade of the Atlantic and Pacific seaboards, for, as Mr. Dearborn pointed out, they had been earnestly demanding the free toll privilege for coastwise shipping.

How much and how far exemption will affect freight rates must be left for the future to determine. When doctors of international law disagree, as did Root and Taft and Knox and Choate, it is not for laymen to pass on technical points of interpretation of the Hay-Pauncefote treaty. But Senator Ransdell cast a vivid side-light on the point at issue when he cited to the Senate the fact that distinguished senator after senator who considered and voted on the ratification of the Hay-Pauncefote treaty had announced at that time or afterward that they all voted for it in the conviction that the treaty in no way deprived the United States of the right to favor its coastwise shipping. Many senators declared of their action at that time that, if the contrary opinion had prevailed, the treaty would most certainly have been defeated.

United States Not Deprived of Right to Favor Its Coastwise Shipping

As a matter of fact, Senator Bard of California offered an amendment to the effect that "The United States reserves the right in the regulation and management of the Canal to discriminate in respect of the charges of traffic in favor of vessels of its own citizens engaged in the coastwise trade." This amendment was defeated—but, as the senators who then sat in the chamber uniformly testified, defeat was due to the general belief that such an amendment was superfluous—that the treaty did not limit in any way the power of the United States to deal as it might see fit with its coastwise ships and its domestic carrying. This is by all means the most significant development of the Senatorial debate.

It used to be a political custom to denounce protective tariffs as unconstitutional. But the ready answer always was that the Federal constitution was written by the very public men who in 1789 enacted the first protective tariff law "for the encouragement and protection of manufactures." To the thoughtful American people this statement of fact always seemed to be a sufficient answer—and the old Bourbon claim that protective tariffs are unconstitutional long since succumbed to the flight of time.

If the public men who analyzed and ratified the Hay-Pauncefote treaty did not know what that treaty actually meant then no men can know. As Senator Lodge said of the Bard amendment: "I voted against it in the belief that it was unnecessary; that the right to fix tolls, if we built the Canal or it was built under our auspices, was undoubted."

American Shipowners Unanimously Endorse the Borah Bill

As for the shipping men of the United States, they have generally hoped and believed that exemption of American coastwise shipping would prevail. The Borah bill was unanimously endorsed on July 11, 1921, by the Executive Committee of the American Steamship Owners' Association. If there is doubt about the interpretation of the treaty, a majority of the Senate has shown itself ready to resolve that doubt on the American side. An even larger majority of the Senate could undoubtedly be found to be prepared for the support of any aggressive policy for the upbuilding of American shipping.

A great hue and cry was raised before and after action of the Senate on the Borah bill, that it involved "a repudiation of a solemn treaty" and constituted "a course of National dishonor." Epithets always come more easily to some minds than arguments. They do not require so much study and reflection, and there are always with us those superheated partisans to whom their political opponents are always liars and scoundrels anyway.

Would Theodore Roosevelt invite his countrymen to ignore or violate their international obligations? Would Chief Justice Taft deliberately advocate a step which meant everlasting dishonor for America? To ask such questions is to answer them.

Interpretation of Hay-Pauncefote Treaty

The truth is that the language of the Hay-Pauncefote convention unfortunately admits of two contrary interpretations, one of which will be accepted in entire good faith by one group of men, while one will be convincing to the other. There have been divergent views in Great Britain as well as in the United States over the point at issue. The British Foreign Office was undoubtedly sincere when it declared at one time that the British government would have no basis for objection, if exemption from tolls at Panama were confined to bona fide coastwise carriers. It is the purpose of the Senate, as it will be of the House, to grant exemption only to ships with domestic cargoes passing from and to our own Atlantic and Pacific ports, under the terms of the Borah legislation.

It is no difficult matter to determine whether any given ship at Panama is actually engaged in coastwise traffic, even if she is sailing not under enrollment but under registry. The source, destination and character of the merchandise which the ship is carrying are conclusive. Repeated judicial decisions have affirmed that coastwise trade between New York and Galveston is no more a distinctively coastwise trade than trade conducted in American ships between New York and San Francisco. The nature of the traffic is in no way changed by the fact that in order to complete a coastwise voyage a ship has to pass by the ports of other lands and other governments.

The contest in the Senate over the Borah free tolls bill was, broadly speaking, a trial of strength between those public men there who would support vigorous measures for the strengthening of the American merchant marine and those who would oppose them. I would like to emphasize the words "broadly speaking"—for there were men like Senator Lodge of Massachusetts who, though intensely devoted to the cause of the merchant marine in general, were nevertheless constrained by technical considerations to vote against the toll exemption. When on June 15, 1914, the original no toll provision of the Panama Canal Act of August 24, 1912, was repealed under pressure from President Wilson, the result was immediate discouragement of the maritime aspirations of the American people. Shipowners, builders and merchants in this country instantly assumed that a majority of the American Congress was against them, and there was pronounced depression among all American shipping interests proportioned to the frank exultation abroad.

Decisive Vote on Borah Bill Encourages Shipping Interests

Now the situation is entirely reversed. The decisive vote upon the Borah bill powerfully encourages an expectation

that other and more positive and valuable measures for the upbuilding of the merchant marine can count upon the prompt and loyal support of Congress. In this aspect the declaration for toll exemption for coastwise craft at Panama assumes a significance far beyond its actual intrinsic value to the ocean-going ships of the United States.

Defeat of the free tolls bill in the Senate would have been hailed in this country and abroad as indicating that the temper of the "upper house" of Congress was hostile to additional shipping legislation at this time, or even to the enforcement of laws already on the statute books. Any casual reader of European maritime or commercial newspapers can recall confident predictions that the free tolls bill would be defeated and that the Jones law, including even its uncontested features, would no more be enforced by the Harding than it was by the Wilson Administration. Undoubtedly these foreign newspapers have been so informed by their "listening stations" in America. Whatever the other results of the recent vote on free tolls may be, it will undoubtedly create a certain impression abroad that on this question of American ships the American people and their lawmakers are, after all, in earnest.

Hoover Proposes Use of Idle Ships in Coal Trade

THE Shipping Board has announced the receipt of a proposal made by Secretary Hoover of the Department of Commerce that idle ships be leased at $1 a month for the purpose of exporting coal to Europe in routes where America is losing business to foreigners, thereby protecting these foreign routes and giving work to unemployed miners. Mr. Hoover's thought was inspired by the fact that the Shipping Board had hundreds of idle ships and that if use could be made of the ships in the manner indicated a valuable export trade would be provided at a critical time. By this arrangement employment would be secured for miners who otherwise would be subjected to the hardship of unemployment.

The Shipping Board expressed itself as most sympathetic with Secretary Hoover's suggestion and expressed to him its entire willingness to concur and co-operate, providing Secretary Hoover could gain the assurance from private shipowners that they appreciated this move as creating tonnage that otherwise would not exist and therefore did not interfere with private shipowners' business, but rather, as a means of keeping alive a trade that would be lost to private shipowners, if left alone, and, if lost to the hands of Americans, would be lost to us permanently.

The Isherwood Banquet

IN view of the editorial expression in one of Great Britian's leading shipping magazines shortly after the testimonial dinner given to Charles M. Schwab of England's appreciation of what that gentleman had done for the allied cause when he was responsible for the construction of the ships that made Germany's hope of a successful submarine campaign impossible, MARINE ENGINEERING AND SHIPPING AGE is particularly pleased to have been represented at a banquet recently given to Sir Joseph Isherwood in acknowledgment of that gentleman's great constructive contributions to the shipping industry.

The fact that the longitudinal system of ship construction invented by Sir Joseph has been incorporated in the construction of about 1,400 vessels aggregating 12,000,000 deadweight tons carrying capacity shows that he deserves the honors recently given him by the British government, and the fact that the Isherwood system has been used in the construction of a large number of American as well as English vessels also shows what this banquet was intended to convey —the high respect and esteem that we hold for Sir Joseph in this country.

Motorships

IF a private corporation had a three-billion-dollar investment which it was unable successfully to develop, it would without doubt seek the advice of known experts in the industry in which its money was at stake and endeavor by all possible means to try out all reasonable policies so recommended. What, then, can be the excuse of the Shipping Board for neglecting to heed the counsel of Frank C. Munson, president of the Munson Steamship Line, who has demonstrated his ability to operate American steamships successfully and who is one of the few men heading long-established shipping companies in this country?

In brief, Mr. Munson states that the Shipping Board could dispose of at least 500 vessels, if it would convert them into motorships. He declared that, even if it cost from $150,000 to $250,000 to re-engine these ships, they could be readily sold at prices ranging from $350,000 to $500,000. This statement is substantiated by the fact that in the present shipping depression it is the steamship and not the motorship which has to be tied up. The motorship with its Diesel or semi-Diesel engine which requires only from one-third to one-half the fuel to operate that a steam installation of the same power uses and whose auxiliaries are driven by electric motors, the current for which is obtained from oil engine driven generating sets, needs no boilers, condensers, feed pumps or feed water. With the increased revenue earning cargo space thus obtained is it any wonder that 183 motorships of 502,944 gross tons are now building in various countries? The total tonnage of shipping under construction in America, according to the latest returns from Lloyd's Register of Shipping, shows that less than 8 percent—434,000 gross tons—of the tonnage building in the shipyards of the world is being constructed in the United States and of this program only three are motorships.

The duty of the Shipping Board, according to the Jones Act, is to determine what are the best types of ships and what are the most efficient, most modern and most economical types of propelling machinery. The Shipping Board has very properly re-engined several freighters with the turbo-electric drive, giving that type of marine propulsion an opportunity to demonstrate its efficiency. Why not try out a few motorships? Mr. Munson states that the 500 steel cargo ships ranging from 3,000 to 7,000 tons that are now tied up should be equipped with Diesel engines and that with these vessels so converted we could laugh at foreign steamship competition. Our higher wage scale, he declared, would be more than offset by the economies of operation, quick turn around and the driving force of American organization.

Of what use will it be to develop a shipping policy that will equalize the difference in cost of operation between American and foreign steamships if by the time we get the policy working we find that the foreign countries have with their motorships created another differential in their favor, which is equal or greater than that which now exists? Surely the Shipping Board cannot permit this to occur by keeping 500 vessels tied up that can be profitably converted into motorships.

With motorships aggregating over half a million gross tons under construction abroad our competitors in overseas shipping are not only adding several hundred highly efficient vessels to their existing merchant fleets but they are at the same time gaining valuable experience in the development of Diesel engines which our engine builders lack. Without such experience our ship and engine builders are seriously handicapped in providing our shipowners with the most efficient and economical types of vessels.

Wage Subsidy Proposed for the Merchant Marine

By Waldon Fawcett

Added to the obvious point of contact, there are many inducements to interest American shipping interests in the outcome of the international disarmament conference at Washington. With the governmental polices of many nations with respect to the merchant marine governed by the exigencies of their naval establishments and with many of the world's shipyards and ship repair plants sustained in great part by naval patronage, it cannot be otherwise than that any radical change in naval programs and ideals would have a reaction upon the merchant marine.

OF close interest to shipowners and ship operators is the effect of the movement for the limitation of armaments upon nations which have been wont to contribute to the upbuilding and maintenance of their respective merchant fleets by means of subventions granted to vessels designed to permit of quick conversion from passenger or cargo craft to transports or supply ships. Certainly, there has been revealed a bond between the disarmament issue and the status of the personnel of the merchant marine. Particularly is this the case in the United States where an element of deepened significance is injected because of the disparity between the wages of foreign and American seamen.

Specifically, there hangs upon the result of the disarmament conference the fate of a bill recently introduced in the United States House of Representatives by Congressman Butler, the undeclared but manifest purpose of which is to aid the American merchant marine by a unique form of ship subsidy. The pending measure, which is designated H. R. 240 and which is now before the Committee on Naval Affairs of the lower house of Congress, is entitled "A bill authorizing the enrollment of officers and men of the merchant marine in the Naval Auxiliary Reserve." That caption gives such slight hint of the inner significance of this bill that it is perhaps not strange that shipping interests did not instinctively sense its importace. Gradually, however, its potentialities for the encouragement of the merchant marine have made appeal to the imagination of practical shipping men and the author of the bill has lately received most emphatic expressions of approval from leading executives in shipping circles.

Provisions of the Butler Bill

The Butler bill provides comprehensively that all officers and men who are employed in the seaman or engineering departments of seagoing vessels flying the United States ensign and who are citizens of the United States shall hereafter be eligible for membership in the Naval Auxiliary Reserve and shall be enrolled therein upon application and given a provisional rank or rating without examination of any kind and by so enrolling shall obligate themselves to serve in the Navy in time of war during the existence of a national emergency declared by the President. Enrollment, according to the stipulations of the bill, shall be for a period of four years or for a shorter period, corresponding with the time an applicant may be obligated to serve in the merchant marine but in no case for a period shorter than one year. It is required, furthermore that all members of this class, other than those of commissioned rank shall serve two months aboard a vessel of the United States Navy during each twelve-month period after enrollment.

Retainer Pay for Naval Reserve

Tangible encouragement for the American shipping interests, that have been handicapped in a competitive sense by high wage standards, is contained in Section 5 of the Butler Bill which provides for "retainer pay" for members of the proposed new class. For officers the pay would be, following confirmation, one month's base pay per annum of the corresponding rank in the Navy. For men there would be an allowance, before confirmation, at the rate of $120 per year and after confirmation at the rate of $180 per year.

That observance of the annual training period aboard naval vessels is to be taken seriously under the new project is attested by the provision in the pending bill that no retainer pay shall be paid to any member of the projected class who fails to perform his alloted duty with the regular Navy. Moreover there is to be no payment until the obligation for naval service has been discharged, when the retainer pay from the date of enrollment will be paid in one sum. In addition to the "retainer pay," above mentioned, there is to be paid to the reserves from the merchant marine, while serving in the regular Navy an amount equal to all pay and allowances which would have been due them from their regular employers during the time of their absence with the Navy plus the Navy pay and allowances of their provisional or confirmed rating.

Plainly the intent of the bill is to create a permanent, dependable reserve whose members look upon their incidental naval duties as a life work. To this end it is provided that if members of the auxiliary reserve class, who have been confirmed in an enlisted rating, sever their connections with the merchant marine, their retainer pay thereafter shall be two months' base pay of the corresponding Navy rating so long as they continue to perform active service with the Navy. Thus there is provided a means whereby the Government would keep a light hold upon men qualified for sea service and, incidentally, it is suspected that the prospect of an ever-waiting bonus might operate to draw back to the merchant marine capable seamen who might be tempted to abandon a seafaring life for some other form of employment, with which they would in time become dissatisfied.

Cash Gratuity for Twenty Years' Service

As further incentive to the same end it is authorized by the proposed law that enrolled members who have completed twenty years of service in the Naval Auxiliary Reserve and who have performed the amount of service required by the law during each term of enrollment shall, upon their own application, be retired with the rank and rating held by them at the time and shall receive in lieu of any pay a cash gratuity equal to the total amount of their retainer pay during the last term of enrollment. The requirements as to qualification for confirmation in rank and rating are, it may be explained, to be prescribed by the Secretary of the Navy, but under no circumstances can the holder of a provisional enlisted rating be confirmed who has not had at least two months' service in the regular Navy either prior or subsequent to enrollment.

Inasmuch as the benefits of the contemplated law would be available only to officers and men who are employed on "sea-going vessels" the definition of a sea-going vessel, within the meaning of the act, would upon occasion be likely to become a matter of importance. In order to provide for this contingency the Secretary of the Navy is empowered to determine whether or not a vessel is a sea-going vessel. In this same connection the Butler Bill also provides that hereafter all sea-going vessels flying the United States ensign shall be

subject to such inspection as may be prescribed by the Secretary of the Navy.

Encouragement for All-American Personnel

The proposition to equalize the wages of foreign and American seamen by making up the excess received by our sailors through a naval retainer pay in return for which the Government would acquire an efficient Naval Reserve has been advocated for several years by such men as Admiral Bowles, Captain McAllister and others. Mr. Butler is a staunch friend of the movement for the upbuilding of the merchant marine, and his feeling is that a naval auxiliary reserve of at least 60,000 men enrolled from the personnel of the merchant marine would operate to strengthen the entire shipping industry and encourage an "all-American" personnel in the merchant service. While certain of its features have been embodied in previous legislative propositions, the Butler Bill in its entirety is accounted a unique, original suggestion. The General Staff is understood to favor the plan and, despite the fact that the bill is patently on the "waiting list," considerable sentiment in its favor has appeared spontaneously in Congress. The future of the Butler Bill depends upon the impress upon future U. S. naval policy made by the disarmament conference. If there is to be no check to the present trend of development, the Committee on Naval Affairs stands ready to inaugurate hearings on the Butler Bill with the idea of obtaining the views of practical men in naval and shipping circles and possibly making any changes in the wording of the bill that might seem desirable.

If the Butler Bill does not supply the sorely-needed panacea it is obvious that some other means must be sought, and speedily, too, to equalize or reconcile the disparity between the operating costs of foreign and American ships. This handicap upon the American merchant marine constitutes a problem that obtrudes, nowadays, upon almost every issue of public policy that involves transportation. It is an element that figures, for example, in the current drive to exempt vessels of American registry from the Panama Canal tolls. And the issue is intensified, by the by, in consequence of the continual agitation that American ships be manned exclusively by Americans.

"American Wages a Handicap," Says Lasker

In enumerating, in his address of October 5, the problems of the American merchant marine and the necessities to be met if private operation of the government fleet is to be profitable, Albert D. Lasker, chairman of the Shipping Board, placed first on his list the handicap of high wages, closely followed by the related obligations of expensive victualing and severe legislative requirements. He acknowledged that if American living standards are to be maintained on the seas as on land some means must be found to meet the difference between American and foreign wage standards, both in the shipyards and in the entire field of ship operation.

The disproportionate cost of operating American ships is a subject whose gravity and insistence was revealed during the Congressional hearings that preceded the passage of the Merchant Marine Act or the Jones Act, so-called, and that was emphasized during the Congressional investigation of the Shipping Board. For example, some months ago there was laid before a Congressional committee figures on the cost of wages and board per month on ships of different nations which showed that if the United States cost of operation be made the basis of computation as an allowance of 100 percent, the British cost is 54 percent, the Canadian cost 34 percent and the Japanese cost 17 percent. That the Canadian cost should be 66 percent less than the United States average has been accounted particularly significant.

Some members of Congress, who have, perhaps, looked into the matter only superficially, have been prone to reason that if the standards of the ports govern the wages of seamen there cannot be any excessive hardship for ship operators even though the American wage scale rules higher than that of any other country. Practical shipping men, as, for example, Mr. P. A. S. Franklin, have endeavored now and then to point out to misguided Congressmen that when an American ship enters a foreign port it is only a small percentage of the men who desert and are replaced by others at a lower wage. Similarly the foreign ship, setting forth with a low-pay crew, loses by desertion at her American port of call only a small proportion of her personnel who must be replaced at the higher scale. Under the Butler Bill, American seamen would have, to be sure, added incentive to cling to their places, but on the other hand the differential paid by the Government would go far to take care of the ship operator's extra burden.

Specific Example of Wage Disparity

When the Commerce Committee of the United States Senate was drafting what was to become by enactment the Merchant Marine Act of 1920 it was supplied with figures that showed in detail the serious consequences of that wage disparity that the Butler Bill would go far to correct. For example, Frank C. Munson made his memorable comparison of the British steamer *Munarden* and the American steamer *Walter D. Munson,* the former a coal burner and the latter an oil burner, but chosen for comparison because each carries a crew of forty-two men. The pay roll of the British vessel was given as 733 pounds sterling as compared with a monthly pay roll of $4,262.50 on the American vessel. If six men were added to the crew of the *Walter D. Munson* to make her a coal burner, thereby affording an even basis for comparison, the disparity of the monthly pay roll would be increased by $540, in addition to the expense of victualing the six extra men.

The pay or wage disparity between American and foreign scales has always been sufficiently marked in the case of every class of ship personnel to constitute a balance of power in competition. During the past few years, however, it has been particularly marked in the case of officers. Thus, a difference of perhaps 25 percent (at post war rates of exchange) in the pay of British and American able seamen has been overshadowed by a gap between the compensation of officers of the two nationalities, indicated when the pay of the captain of the *Munarden,* 42 pounds sterling per month, is set over against the $343.75 allowed the captain of the *Walter D. Munson,* and when the average pay of the mates on the British vessel, 22 pounds sterling, is placed in deadly parallel with the stipend of $586.25 for three mates on the American ship. The chief engineer of the British steamer receiving 30 pounds sterling per month has responsibilities equivalent to the chief engineer of the American oil burner, who is paid $318.75 per month.

Provides Decisive Advantage Regarding Officers

Experienced operators, such as Mr. Munson, have declared that British shipowners have operating costs that are on an average 40 percent lower than the American, principally because of the inequalities in pay. They have conceded the claim that with respect to the ordinary personnel of a ship —the seamen, firemen and coal passers—there may be something in the contention of the labor leaders that a foreign ship coming into United States ports regularly will be all but compelled to raise wages to an approximation of the American standard. But that is not true, it is insisted, in the case of the officers. The foreign officers stick by their ships, giving the foreign owner the benefit of an appreciable saving. That this is a decisive advantage in a competitive sense will be accepted when it is considered that on many a vessel the expense of operation is pretty evenly divided between payments to officers and payments to or on behalf of crew instead of the bulk of the outlay going to enlisted personnel other than officers.

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Developments In Marine Insurance

Concrete Ships—Lake Hulls—Motor Boats—Shipowner's Liability — Contributory Values — Unrepaired Damage

By "Bordereaux"

IN the judgment of the great majority of marine underwriters the concrete ship has not demonstrated her acceptableness as an insurable risk. They observe with open skepticism the efforts of exponents of this form of vessel construction in endeavoring to convince the shipping world of its superiority. It has recently been said that the only major defect so far developed in the concreter is her small resistance to local shock, as, for instance, when she bumps into a dock, and that this is negatived by the ease and inexpensiveness of repairs. They tell the underwriters that recently a concreter was repaired in four hours, and at a trifling cost; that her crushed stern was made whole again by the simple device of listing her, chipping out a space four feet by five, and pouring in the cement. It would have taken two weeks to effect the repair of such an injury to a steel vessel. But the underwriter shakes his head and replies that, aside from lasting qualities, the concrete hull will always weigh more than a steel one of equal displacement and that concrete ships can be successfully employed only on routes where space rather than tonnage cargoes predominate. This alone, they argue, would preclude the use of concrete vessels as tankers. In this connection it is interesting to remember that the American Bureau of Shipping gives the "experimental" classification to concrete vessels, as also does London Lloyds. Full classification, though denied at the present time, may come eventually, if warranted by experience.

As an ocean-going cargo carrier it is too soon to pass definitely upon the value of the concreter, though she has proved her usefulness as a harbor craft. Despite the improvements in concrete construction since California gave us the famous *Faith,* the material now employed being much lighter and stronger, the underwriter remains doubtful as to the effects of engine vibrations, endurance in casualties, etc. Insurance rates on the *Faith* were, in many particulars, much higher than those charged on steel vessels. When builders proposed to overcome the defect of weight by reducing the thickness of the hulls, the underwriters objected on the ground that a thinner hull, combined with the porosity of the cement, might allow the water to reach the steel reinforcement and seriously weaken it through rusting. They cannot forget how the concrete steamer *Cape Fear* crumbled to pieces and sank with the loss of seventeen of her crew when she collided with the steel steamer *City of Atlanta,* less than a year ago.

Lake Hull Insurance

LAKE hull insurance has shown, so far, a slightly better margin of profit than in recent years; but perhaps a less attractive account will have to be recorded before navigation closes and the fall storms have taken their customary toll of the underwriter. Hull valuations at $70 per gross registered ton do not tend to over-confidence. As usual, the Great Lakes Protective Association covers the first 25 percent of the lake fleet at 3¼ percent. Disbursements are covered in the general market, and particular average claims come under a 3 percent franchise. The experience of the Great Lakes Protective Association for several consecutive years has been an underwriting deficit of about $250,000. The insurance on the two thousand or more vessels in the Great Lakes fleet is placed by a comparatively small number of brokers and is, in the main, carried by the old line companies.

In view of the low valuations the warranty found in ocean hull policies, limiting the disbursements insurance to 15 percent of the hull value, is omitted from the form of the lake hull policy, leaving the owner at liberty to insure any amount he desires on this interest. "Detention earnings" is a form of insurance more commonly used by owners of lake vessels than by those of ocean-going steamers. This cover commits the underwriter to pay so much a day, according to the amount of the policy, for each day in excess of seven days and not exceeding twenty-six days, that the vessel is detained by casualty, other than total loss, from performing her service. The rate is 4¼ percent. The rate on steel vessels is always the same; that is, 3¾ percent, which is about 3⅜ percent net to the assured.

Under the regular form of lake policy the vessels insured are allowed to navigate the waters, bays, harbors, rivers, canals and other tributaries of the Great Lakes, not below Lake Erie. For an additional premium smaller vessels may have their navigation limits extended to include trips as far down as Montreal. Steel vessels are warranted to be laid up out of commission between November 30 and May 1, on account of the severe winters and the perils from ice. In consideration of an additional premium steel steamers may be permitted to navigate in the early part of April and as late as December 12. But ice claims are payable on damage sustained during these sailings only in excess of 3 percent on the entire valuation. Such early season losses sometimes reach the neighborhood of $200,000. An analysis of lake claims shows that most of them are occasioned by ice damage, with the striking of bridges, docks and similar obstacles running a close second.

Motor Boats Disliked

LAKE motor boats are not in good standing with underwriters. They have lost too much money on them. And the chief reason for this dislike lies in the inexperience of the men who run them—that is, their owners. It is quite a different thing to handle a motor boat engine and to run an automobile, but not every owner realizes this at first. Feed pipes clog very readily; and careless use of cigarettes in the area affected by the overflow results in instant and stubborn fires. Higher-priced boats, from $10,000 to $25,000, are readily insurable, for the reason that experienced engineers and competent crews are usually on them. Motor boats employed for commercial purposes are practically uninsurable; the moral hazard looms ominously in craft so exposed as these to loss of profit.

Shipowners' Liability

UNDERWRITERS regret the evident feeling of bitterness entertained toward them by certain steamship interests, due, for the most part, because of the activity displayed by the former in attempting to have the Harter Act so amended as to compel the carriers to live up to the obligation imposed by the relationship existing between carrier and shipper. It should always be remembered that the underwriters have nothing to lose as a result of the carriers evading their responsibilities; it merely means that if the underwriters

are forced to assume the burdens which properly belong to the carriers the rates will have to be increased to a point where the premiums will offset the losses.

It is believed that the faults will be eliminated very quickly, if carriers are held to a strict accountability, but that otherwise we will have a repetition of the pilferage fiasco—an ever-increasing carelessness, with corresponding increases in losses. The economic waste thus entailed is never overcome by mere compensation for losses, many of which could be obviated by proper precautions. It is hoped by the underwriters that the carriers will come to see the situation in this reasonable light, as so much depends upon close cooperation between shipowners, shippers and underwriters in the upbuilding of our hoped-for foreign trade.

The "Shipped" Bill

IN the second interim report of the Chamber of Shipping and Pilferage, recently received from England, the phrase "received for shipment" is discussed in an important and direct manner. The recommendation of the Chamber's committee is as follows: "The custom of issuing bills of lading for goods 'received for shipment,' except where the circumstances make no other form appropriate, should be discouraged, as it gives scope for pilferage, and in no case should shipowners, under whatsoever pressure from merchants, issue a 'shipped' bill of lading until the goods are on board the steamer, as the difficulties of protecting the steamer against claims for pilferage which may have happened before shipment are thereby greatly increased."

Contributory Values

THERE appears to be considerable confusion in the mind of the layman as to the basis of contributory values in general average. The proper test to apply is, "What value did the party receive which he would not have received if vessel and cargo had perished?" Property contributes on the basis of net arrived values, thus cargo pays on its landed value less cost of landing, such as duty, destination, freight, cartage and expenses at port of refuge. Likewise the vessel pays on its damaged arrived value, less costs of temporary repairs which may have been made subsequent to the disaster. The value made good must itself contribute.

Identical Ownership

IDENTICAL ownership barred recovery in a recent interesting suit by a marine insurer against the United States Railroad Administration. It was the case of the Globe and Rutgers Fire Insurance Company vs. Hines, agent, 273 Federal Reporter 774, and both vessels in the collision were the property of the Railroad Administration. In giving judgment for the defendant the Court of Appeals made some interesting points. It was held that an underwriter of marine insurance who paid a loss resulting from a collision against an insured vessel and another is subrogated to the rights of the insured owner of the vessel against the other vessel in regard to the loss. The marine underwriter can only recover when the insured could have recovered. There can be no right of subrogation in favor of the marine underwriter for loss paid on a ship injured in the collision where the injured ship and the one which was responsible for the injury are owned by the same party.

Negligence and Liability

DOUBTLESS some of our readers have wondered at times just what liability rests with a marine underwriter in event of a vessel striking a reef and sinking when the day is clear and the sea calm and the disaster is unquestionably due to the negligence of the master. The answer is that the underwriter must pay. As a reef is one of the perils that lurks in the deep it comes under the definition of "perils of the sea." The fact that the day was clear and the sea calm and the master's negligence was responsible for striking the reef cannot relieve the underwriter from liability. He undertakes to cover loss or damage due to perils of the sea, and does not limit this undertaking to a certain state of weather or condition of the sea. Nor does the basic form of policy contain any clause whereby the underwriter would be excluded for an insured loss simply because it was occasioned by negligence.

The Hudson River Bridge

THE proposed pontoon bridge over the Hudson River is being contemplated with some misgivings by inland hull underwriters. They realize that the risk on the larger vessels operating on the Hudson may be materially increased by the construction of a bridge such as the one now under consideration. Says one underwriter, "The wooden ships were enough of a nightmare to insurers during their sailing days without having them arise from their graves to again haunt us."

Bill of Lading Notations

THE question is often asked whether a steamship bill of lading stamped "not liable for pilferage" relieves the ocean carrier from liability for loss through pilferage. The Harter Act prohibits the shipowner from making any notation on the bill of lading relieving the carrier from liability for loss or damage arising from negligence, fault or failure of proper loading, stowage, custody, care or proper delivery of cargo, and renders void any words or clauses in bills of lading or shipping receipts which tend to abrogate this liability.

Unrepaired Damage

UNREPAIRED damage often involves underwriting complications. An interesting light on the subject was cast, not long since, by so eminent an authority as Justice McAvoy of the New York Supreme Court. In the course of his opinion he observed: "The rule of maritime jurists as to liability of insurers is that the vessel's owners or the assured should receive the amount of estimated damage at the port of distress regardless of the fact that actual repairs might be made for a lesser amount at another port to which the vessel could be towed or proceed upon her own motivation (Pitman v. Universal Marine Insurance Company, 9 Queen's Bench Division, 192; Insurance Company v. Southgate, 5 Peters, 604). This rule, of course, may be averted by specific agreement of the assured and assurer to adopt another media of liquidating damage. The theory that an assured is limited to the actual amount paid for actual repairs would lead to the absurdity that if he made no repairs at all and used the vessel in her damaged condition he could recover nothing (The Keeler, 194 Federal, 342). The survey provided for in case of damage in such an instance would be useless; else why survey when actual cost of actual repairs is the sole criterion?"

Sweat Damage

SO much misunderstanding has arisen over the term "ship's sweat or steam of hold" that many underwriters are discontinuing the use of that phraseology and substituting "actual contact of cargo with sweat of vessel." There is a moisture in the hold of every vessel which does not amount to sweat and for which underwriters should not make themselves liable. This matter has been prominently before the underwriters in recent months in connection with shipments of rubber and other commodities, but they may still be reluctant to make the change in their policies which conservative underwriting demands.

RECONDITIONING THE LEVIATHAN.—Estimates for reconditioning the *Leviathan*, specifications for which were sent to shipbuilders on October 29, place the cost at over $8,000,000. The cost of converting the vessel from a coal to an oil burner will probably amount to $1,250,000.

Are You a Shipping Man, á la Edison?

Questions That Thomas A. Edison Might Ask to Test the Qualificaitons of a General Shipping Man

By "Old Scotch"

So many readers were interested in the 100 questions propounded in a recent issue to test the qualifications which Mr. Edison, were he a shipping man, might propound for prospective marine engineers to enter his employ, that I have been asked to prepare a similar set of questions applicable to the requirements for a general shipping man.

As stated in the prelude to the engineering questions, the standard set by Mr. Edison involves a fair understanding of historical facts, general information and technical lore connected with the profession. In this case they will, in general, be simple questions which should be answered offhand by one versed in the art: if they require you to hunt up references on the particular subject involved, that will help you to retain the information sought after. In any event, if you think that you are a fairly well informed ship man, just give yourself an examination in the following questions and do your own marking.

If you conscientiously can award yourself a mark of 70 percent, then we will recommend that you be put on the "waiting list," that is waiting until Mr. Edison gets out of the electrical business and goes into shipping. I don't know how long this will be and no one else does. Here they are:

1. What is meant by a bare-boat charter?
2. What is meant by a time charter?
3. What very important service did the *Great Eastern* perform before she was broken up?
4. Name three important steamship lines operating in the North Atlantic.
5. What duty does the United States Government alone perform yearly for all the leading maritime nations, as a direct result of the loss of the *Titanic?*
6. What is barratry?
7. Why are ships classified?
8. What is "particular average" in connection with marine insurance?
9. Where are the Grand Banks?
10. What precautions should be taken before a man is allowed to enter a tank which has contained fuel oil or cargo oil?
11. What is meant by a 3-inch line?
12. What articles should be kept at all times in a lifeboat on a sea-going vessel?
13. What relation does the scope of an anchor chain bear to the depth of water in which a vessel may be anchored?
14. Who invented the first deep sea sounding apparatus?
15. What are the advantages of stockless anchors over the ordinary type?
16. What is the best material for treenails in wooden ships?
17. What kind of wood is generally used for sheaves in blocks?
18. What is a snatch block?
19. Of what material is oakum made?
20. How many cubic feet in a so-called cargo ton?
21. How many cubic feet of living space must be provided for each seaman in American ships?
22. What transatlantic liner was first given the appellation of "greyhound?"
23. What is dunnage?
24. What was the name of the American naval officer who first laid out the so-called Atlantic lanes?
25. Which is further east, Valparaiso, Chile, or Valparaiso, Indiana?
26. Under what circumstances would a sea-anchor be used?
27. Wherein does the action of the gyroscopic compass differ from the ordinary magnetic compass?
28. What famous Englishman lost his life in searching for the Northwest passage?
29. What are the duties of the United States Commissioner of Navigation?
30. How much life boatage is required on an American sea-going freighter?
31. What is great circle sailing?
32. On what basis are pilotage fees usually charged?
33. What was the name of the only seven-masted schooner ever built in this country?
34. What is the meaning of C. I. F. in shipping circles?
35. What is a harness cask and why was it so named?
36. Name the most famous line of American transatlantic steamers, prior to 1860.
37. Why are the sails on many small vessels in European waters red instead of white?
38. Where is the cross-jack yard on a full-rigged ship?
39. Why were double top-sails adopted on square riggers?
40. Who wrote the first great American treatise on navigation?
41. Why were wooden vessels copper-sheathed below the waterline?
42. Who named the Gulf stream?
43. What is the youngest age at which a master or chief engineer can secure a license from the Steamboat Inspection Service?
44. What is the largest vessel in the world, now afloat?
45. Who is the present chairman of the United States shipping Board?
46. How many life-preservers must be carried on American vessels?
47. What is the smallest sized steam vessel required to carry a licensed master, under United States Laws?
48. How often must all steam vessels in the United States be inspected by the Government?
49. What is general average, pertaining to marine insurance?
50. What is a P. P. I. marine policy?
51. Why are bilge keels used?
52. What is an orlop deck?
53. What is a shelter deck?
54. What is a sheer strake?
55. Why is it made heavier than other strakes?
56. What is a bridge deck bunker?
57. What is a three-island ship?
58. If a merchant ship has been damaged, what certificate is necessary before she again proceeds to sea?
59. What is a block coefficient?
60. Give an average percentage of block coefficiency for a freighter.
61. When cargo is carried at "ship's option, weight or measurement," what is meant?
62. What is the ordinary capacity of a cargo winch in tons?

(*Concluded on page* 824)

Officers and Committee Members of the Marine Equipment Association of America

(1) Col. E. A. Simmons, Simmons-Boardman Publishing Company, president; (2) K. L. Ames, Jr., American Steel Foundries, secretary; (3) Frank Hatch, Shephard Electric Crane and Hoist Company, chairman of entertainment committee; (4) J. C. McQuiston, Westinghouse Electric and Manufacturing Company, executive committee; (5) H. F. Alexander, Pacific Steamship Company, executive committee; (6) G. W. Selby, Marine Decking and Supply Company, executive committee; (7) I. D. Sarles, Pyle-National Company, executive committee; (8) Captain C. A. McAllister, American Bureau of Shipping, chairman of joint committee of the Society of Naval Architects and Marine Engineers and the Marine Equipment Association; (9) H. L. Hibbard, Cutler-Hammer Manufacturing Company, executive committee; (10) F. C. Bradbury, Crane Company, executive committee; (11) W. A. Cather, Worthington Pump and Machinery Corporation, chairman of publicity committee; (12) G. C. Fuller, The Superheater Company, joint committee of the Society of Naval Architects and Marine Engineers and the Marine Equipment Association.

(1) Stevenson Taylor, President, American Bureau of Shipping. (2) Rear Admiral W. L. Capps, U. S. N., President, Society of Naval Architects and Marine Engineers. (3) H. H. Raymond, President, American Steamship Owners' Association.

A Successful "American Marine Week" Is Assured

Plans for First Cooperative Marine Exposition Ever Held in This Country Nearing Completion—Opens on November 14

Technical Committees to Inspect Exhibits — Marine Engineering and Shipping Age to Issue a Daily, Reporting Programs, Speeches and News

THE Marine Exposition, which is to be held at the Central Mercantile Building, Sixth avenue, between West 18th and West 19th streets, New York city, during the week of November 14, promises to be the greatest all-marine gathering ever held in this country. The determination of the shipbuilders, shipowners and ship operators to get together and present a united force for the preservation and development of our merchant marine is reflected in the decision of the American Steamship Owners' Association to have its technical committee represent that organization on Steamship Owners' Day at the exposition. The same spirit is also true of our own classification society, the American Bureau of Shipping, which has called a luncheon meeting of its technical committees at the Engineers' Club on Thursday, November 17, and of the Atlantic Coast Shipbuilders' Association, which has offered the facilities of its office for the distribution of tickets and literature to its members.

When one considers the support given to the coming exposition by the above-mentioned organizations in addition to the backing of the Society of Naval Architects and Marine Engineers which expects to have 1,000 of its 1,755 members in attendance at its annual convention November 17 and 18 and also the cooperation of the American Society of Marine Draftsmen, which has arranged to hold its annual convention on November 17, 18 and 19 in order to coincide with the week of the Marine Exposition, it is evident that the first concerted effort to make "American Marine Week" a time of combined gatherings of marine associations has met with unqualified success.

In recognition of the value of "American Marine Week" as a factor in creating a national realization of the relation of our merchant marine to our future prosperity, the Marine Equipment Association has spared neither time nor expense to perfect all business and social arrangements. Days and evenings will be given special names, such as Navy Night, Shipping Board Night, Shipowners' Day and Naval Architects' Day and on each occasion appropriate speeches will be made by prominent speakers. In order that the programs, speeches and news of this great event may be given the publicity it deserves, MARINE ENGINEERING AND SHIPPING AGE will issue a daily edition which it will distribute every morning at the exposition. While the *Railway Age* has issued daily editions at railroad conventions for many years, this is the first time that it has been attempted by any publication in the marine field.

Invitations to attend the exposition have been sent to the delegations attending the conference for the limitation of armaments, the foreign naval commissions and the naval attaches of the foreign embassies. As a large number of these distinguished people are interested in shipping and as the embassies courteously furnished their names with expressions of interest, there is no doubt of a large attendance of these gentlemen who will carry back to their respective countries the knowledge of what America can do in the construction of ships and their equipment.

SPECIAL EXHIBITS

In addition to this the exhibits of the United States Navy and the Shipping Board will be of particular interest to those attending the conference for the limitation of armaments, and to a great number of naval experts from all over the world

who will be in New York at this time. The Navy Department will exhibit over 150 special items representing the Bureaus of Construction and Repair, Ordnance, Engineering, Navigation, Marine Corps and Aeronautics. The Shipping Board will show a 50-foot model of the latest type of 535-foot combination passenger and cargo steamer and a model of a standard stateroom.

The body of the exposition will contain much that is new and up-to-date in marine equipment, affording an opportunity for all shipping men to keep abreast of the developments in the marine field. The necessity for successful men to know all about the equipment used in their profession is obvious and attending an exposition of this sort is the best way to get this knowledge. Shipping and shipbuilding concerns will profit by requiring at least one of their staff to file a report of the important improvements and new devices exhibited.

American Steamship Owners' Association

The American Steamship Owners' Association will be officially represented at the Marine Exposition by their technical committee which will attend in a body on Wednesday afternoon, November 16, at 3 o'clock. Wednesday is Steamship Owners' Day and this committee is particularly fitted to represent that body of men because it is their duty to advise the steamship interests on all matters of a technical nature. While these men individually decide upon what type of equipment their respective companies will use in their ships, they also influence to a large extent the procedure that the American Steamship Owners' Association adopts for the good of our merchant marine. The technical committee studies such prospective legislation as the subdivision of ships by transverse bulkheads, the load line, the disposal of oily residue and the rules for the inspection of steamboats. As a result of these studies the Congressional committees are furnished with facts relating to the merchant marine that they may refer to in the formulation of rules and laws. The members of the technical committee are as follows: William F. Gibbs, chief of construction, International Mercantile Marine Company, chairman; John H. Telford, superintending engineer, Munson Steamship Line; A. S. Hebble, superintending engineer, Southern Pacific Company, Atlantic Steamship Lines; James Donald, president, States Marine and Commercial Company; Warren F. Barry, superintending marine constructor, Fall River Line; C. E. Ward, Jr., vice-president Merchant Shipbuilding Corporation, representing United American Lines; R. W. Morrell, marine superintendent, Tide Water Oil Company.

American Bureau of Shipping

The American Bureau of Shipping is strongly in favor of the growing tendency of marine organizations to get together. In recognition of the value of the united action displayed by the marine societies which are backing the Marine Exposition, the bureau has called a luncheon meeting of its technical committees at the Engineers' Club, New York City, at 1 o'clock Thursday, November 17; and all of them will naturally attend the exposition. As these committees are formed to give the technical staff of the American Bureau of Shipping the opportunity to obtain the opinions of the best naval architects and marine engineers in the country, the assurance of their attendance and cooperation during "American Marine Week" is highly significant.

The exposition will be formally opened at 2 o'clock Monday afternoon, November 14. On other days it will open at 10 a. m. and it will close every evening at 10 p. m. Between 10 a. m. and 7 p. m. it will be closed to the public so that those engaged in the shipping business may talk in comfort. After 7 p. m. it will be thrown open to the public and every effort made to convey to all industries the realization of the relation of our merchant marine to our future prosperity.

Badges having distinctive colors will be provided for the business, professional men and guests attending the exposition. Every one who registers will receive a badge having a separate number and complete lists will be published each day in both alphabetical and numerical order giving the names and numbers of the persons who have received badges. This will make identification easy and promote social and constructive acquaintances.

Program of Naval Architects' Meeting

THE twenty-ninth general meeting of the Society of Naval Architects and Marine Engineers will be held at the Engineering Societies Building, 29 West 39th Street, New York, Thursday and Friday, November 17 and 18, 1921. The business sessions will begin promptly at 10 o'clock each day.

This year the afternoon session on Thursday will be devoted to the reading of papers pertaining to electric ship propulsion and will be held jointly with the American Institute of Electrical Engineers. The papers arranged for presentation at the meeting are as follows:

Thursday Morning, November 17.

"The Tactical Relations Between Different Classes of Men-of-War and Their Embodiment in Design." By Rear Admiral W. L. Rodgers, U. S. N.

"Development of the Three Plane Navy, With or Without Battleships." By Mason S. Chace, naval architect.

"American Classification of American Vessels." By W. A. Dobson, naval architect, William Cramp & Sons Ship & Engine Building Company.

Thursday Afternoon, November 17

"Electric Propulsion of Ships." By W. E. Thau, general engineer, Westinghouse Electric & Manufacturing Company.

"Electric Auxiliaries on Merchant Ships." By E. D. Dickinson, mechanical engineer, marine department, General Electric Company.

Friday Morning, November 18

"How Can American Ships Compete Successfully with Foreign Ships?" By W. L. Marvin, vice-president and general manager, American Steamship Owners' Association.

"The Importance of Port Facilities in the Development of Merchant Marine and Commerce." By Rear Admiral H. H. Rousseau, U. S. N.

"American Apprenticeships, Schools and Scholarships." By C. F. Bailey, engineering director, Newport News Shipbuilding & Dry Dock Company.

"Cost Accounting and Estimating." By H. H. Schultze, superintendent estimating division, Bethlehem Shipbuilding Corporation.

Friday Afternoon, November 18

"Design and Construction of Passenger Steamers." By E. H. Rigg, naval architect, New York Shipbuilding Corporation

"The Influence of Shape of Transverse Sections Upon Resistance." By Professor H. C. Sadler and Professor E. M. Bragg, both of University of Michigan.

"Calculation of the Transverse Strength of Submarines by Marbec's Method." By Professor Wm. Hovgaard, Massachusetts Institute of Technology.

"Power and Speed Trials, 10,000 D. W. Ton Tanker." By Professor H. A. Everett, naval architect, Union Shipbuilding Company.

The annual banquet will be held in the Grand Ball Room of the Waldorf-Astoria, 34th Street and Fifth Avenue, Friday evening, November 18, at 7:30.

As has previously been announced, the meeting of the Society is being held during the same week as the Marine Exposition. A committee, made up of Captain C. A. McAllister, chairman; J. Howland Gardner, W. H. Todd, H. H. Raymond and F. L. DuBosque, has been appointed to cooperate with a similar committee of the Marine Equipment Association of America to arrange a satisfactory program for the week of the exposition. In order to afford the members of the society an opportunity to visit the exposition during hours specially set apart for them a taxi-cab service will be operated by the Marine Equipment Association between the Engineering Societies Building, where the society will meet, and the Central Mercantile Building, where the show will

THE EXHIBIT COMMITTEE, MARINE EQUIPMENT ASSOCIATION

(1) W. M. Wampler, The Ellcon Company and Coen Company, Incorporated, Chairman. (2) Robert B. Lea, The Sperry Gyroscope Company. (3) William H. Easton, Westinghouse Electric and Manufacturing Company. (4) A. S. Hoffman, The Griscom-Russell Company. (5) Gardner Cornett, Pneumercator Company, Incorporated.

be held. The exposition will be open from 10 A. M. to 10 P. M., except on the first day, when it will open at 2 P. M. Thursday from 4 P. M. to 7 P. M. and Friday and Saturday from 10 A. M. to 7 P. M. will be known as "Naval Architects' Days."

Program of Marine Draftsmen's Convention

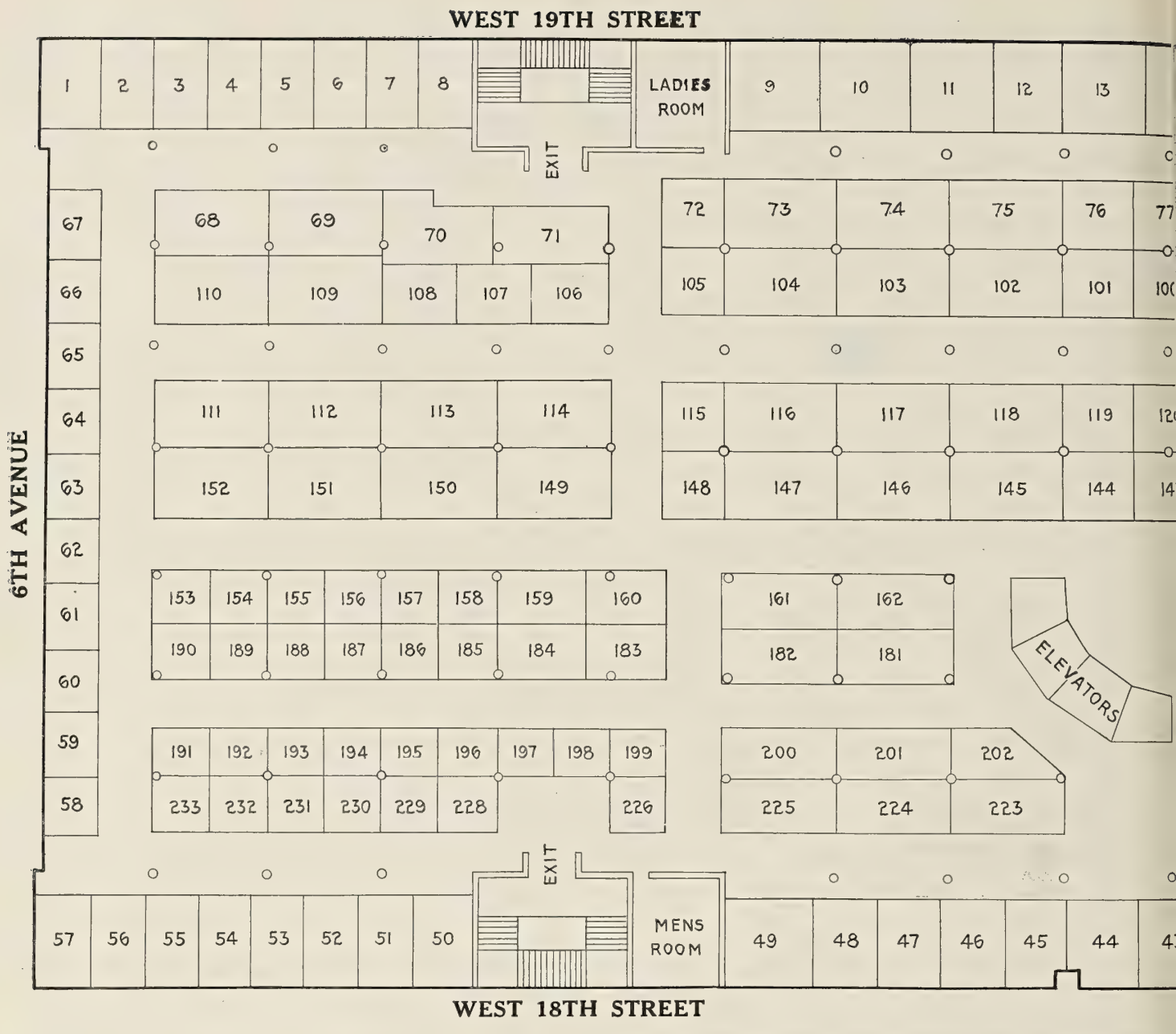
THE tenth annual convention of the American Society of Marine Draftsmen will be held in the Engineering Societies Building, 29 West 39th Street, New York city, November 17, 18 and 19, 1921. The regular business and professional sessions will begin at 10 a. m. each day.

The national executive committee of the society will meet at 10 a. m. Thursday, November 17, in the convention headquarters selected by the local committee at the Hotel Breslin, Broadway, at 29th street, New York, to examine the credentials of the representatives from the following branches: Delaware River, Boston, Quincy, Bridgeport, Hudson River, Connecticut, Bath, District of Columbia, Newport News, Bethlehem and New York.

The auditing committee, composed of members from the Bridgeport, Delaware and New York branches, will meet at the same time and place. In the evening the executive committee and visiting representatives in a body will attend the Marine Exposition, local branch No. 23 participating in the Exposition with a brilliant display of the draftsmen's work.

On Friday, November 18, the regular business session will be held for which the program is roll call, announcements, minutes of the 1920 convention held in Washington, D. C., proposals of amendments to the constitution and by-laws, report of the auditing committee, report of officers, executive, standing and special committees, also reports from the various branches. In the evening the local committee plans a regal reception to the executive committeemen, members and representatives by going in a body to "Get Together," now playing at the Hippodrome.

On Saturday, November 19, morning sessions will be taken up by unfinished business, general and new business, selection of the city for the 1922 convention, nomination and election of officers for 1921-1922. The afternoon sessions will be devoted to the reading and discussion of technical papers and lectures. On Saturday evening the annual banquet and reception will be held at the Hotel Breslin. The local committee, consisting of F. Adler, H. Dunham, R. Doerflinger, W. Robertson and C. Jacobson, promises to have on hand a good entertainment by professional talent and some very able speakers.



Floor Plan of Annual Marine Exposition to Be Held at the C
New York City, No

Directory of Exhibits

The American Brass Company, Waterbury, Conn.—Brass, copper and bronze in sheets, plates, wire, rods, bars and tubes; tobin bronze rods and shafting; turbine blading, brass, nickel and bronze, Cupro nickel and monel metal; condenser tubes, Admiralty and Muntz metal; condenser head plates. Booth 75.

American Car & Foundry Company, 165 Broadway, New York.—Berwick electric rivet heater; Berwick electric scarfing heater; Berwick electric rod heater. Representatives: F. C. Cheston, D. B. Wallace, W. M. Earl. Booth 150.

American Engineering Company, Philadelphia, Pa.—35 horsepower electric winch; electro-hydraulic steerer driven by Hele-Shaw pump and controlled by A-E-Co. hydraulic telemotor; Hele-Shaw electro-hydraulic winch; small electric windlass; steering wheels and stockless anchors. Representatives: P. E. Kriebel, D. C. Spencer, E. B. Bryant, C. V. Koons, F. W. Kay, R. C. Lamond and H. Buckholtz. Booths 81 and 96.

American Manganese Bronze Company, Holmesburg, Philadelphia, Pa.—HY-TEN-SL bronze propeller blade; manganese bronze propeller blade; charts of comparative tests on propeller metals; photographs of installations, etc. Representatives: C. R. Spare, T. H. Addie, D. V. Williamson. Booth 63.

American Steel Foundries, Chicago, Ill.—Dunn anchors. Representative: A. I. Jones. Booth 159.

Asbestolith Manufacturing Company, 1 Madison Avenue, New York.—Asbestolith sanitary fireproof flooring, wainscoting, stair covering, etc., and superior ship decking. Representative: R C. Burnside. Booth 206.

The Ashton Valve Company, 126 Liberty Street, New York.—Safety valves, relief valve, whistles, pressure and vacuum gages, gage and boiler testing outfits. Representative: Charles W. Buckelew. Booth 197.

The Babcock & Wilcox Company, 85 Liberty Street, New York.—Drawings of half actual size of various types of boilers; electric concentration indicator; models of oil burners, headers and all valves and fittings as installed on Babcock & Wilcox boilers. Representatives: J. Coleman, J. H. King, J. Graham, T. B. Stillman, E. A. Colson, C. W. Middleton. Booths 16, 17 and 18.

Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa.—The Bethlehem-Weir line of auxiliaries, which will include: 25-ton evaporator, 14-inch centrifugal pump direct connected to 9-inch by 8-inch vertical steam engine, 9½-inch by 7-inch by 15-inch dual air pump, 3½-inch by 2½-inch by 5-inch feed pump, 8½-inch by 6-inch by 18-inch feed pump, 7¼-inch by 5-inch by 10-inch horizontal fuel oil pump, 10½-inch by 8-inch by 22-inch pair of feed pumps and tank; pump body

rcantile Building, 6th Avenue, Between 18th and 19th Streets, to 19 Inclusive

and valve chest 21-inch by 14-inch by 27-inch feed pump; 7-inch by 8-inch by 18-inch general service pump; 4½-inch by 5-inch by 12-inch general service pump; Bethlehem duplex ram hydraulic telemotor with the transmitter and receiver connected; a complete Bethlehem (Dahl) mechanical oil burning system including pumps and a section of the furnace front; and a representative line of marine valves and fittings. Representatives: K. W. Heinrich and A. V. Reynolds. Booths 163, 164, 179 and 180.

The H. E. Boucher Mfg. Company, 150 Lafayette Street, New York.—Miniature marine reproductions; practical miniature power and sail boats; steam and electric machinery; high grade fittings for exhibition models. Representatives: H E. Boucher, Dwight S. Simpson, F. J. Harjes. Booths 84 and 93.

Brunswick Refrigerating Company, New Brunswick, N. J. —Refrigerating, ice making and water cooling apparatus. Representative: W. O. Whitney. Booth 103.

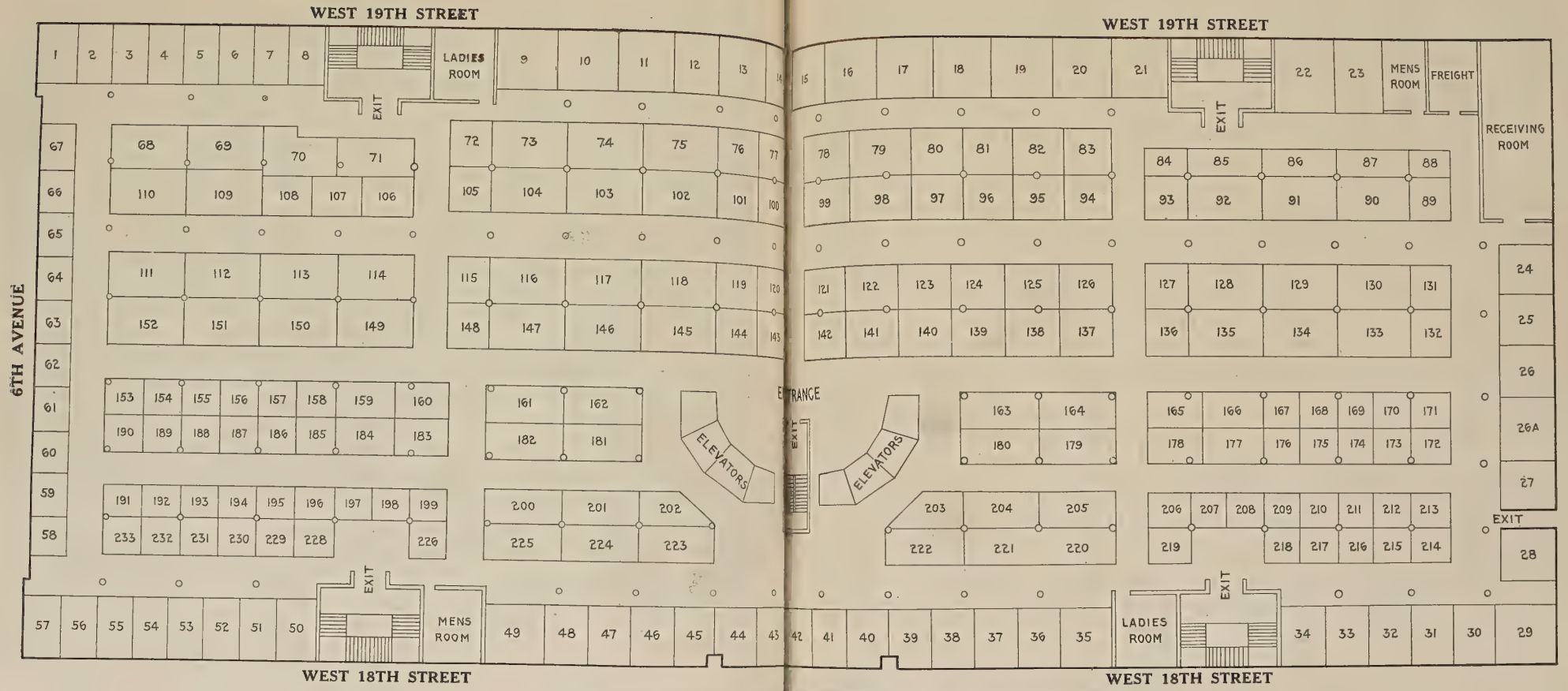
Chase Metal Works and Chase Rolling Mill Company, Waterbury, Conn.—A display of manufactured non-ferrous products such as brass, copper and bronze sheet, rod, wire and tubing. The exhibit comprises the following products: Brazed tubing, showing the original sheet, the forming process, welded seam and finished material; seamless tubing, showing the original billet or cast shell with intermediate sizes during the drawing operations; rods of various alloys, round, square, hexagon and many other shapes, both drawn and extruded; sheet brass, ordinary brass alloys, bronze and nickel silver; wire, coils of wire of various composition, including bronze and phosphor bronze wire; miscellaneous samples of finished products, bent into various forms to illustrate the strength and ductility of rods, wire and tubing; microphotographs showing the crystalline structure of the various alloys and samples of rod and tubing showing the flanging, flattening, expansion, crushing, twisting and other physical tests, for strength, ductility and hardness required by the United States Government and various consumers. Representatives: J. F. Giffin, R. G. Barton, H. B. Snyder, M. A. Joy, A. G. Craft. Booth 20.

James Clark, Jr., Electric Company, 154 Nassau Street, New York.—Electric grinders and electric drilling machines. Representatives: A. H. Briggs and W. M. Briggs. Booth 231.

Coen Company, Inc., 112 Market Street, San Francisco, Cal. —Mechanical oil burning equipment; cleanable oil heater; various size oil strainers; oil burners; furnace fronts. Representatives: Wm. M. Wampler, F. Hall, H. B. Chamberlain, F. S. Harper. Booth 136.

The Crandall Engineering Company, East Boston, Mass.— Photographs, etc., of dry dock installations. Representative: J. Stuart Crandall. Booth 58.

Crane Company, Chicago, Ill.—Complete line of valves and fittings for all types of ships. Representatives: F. C. Bradbury, J. F Duffy, E. Morgenthal and G. E. Barker. Booths 116 and 147.



Floor Plan of Annual Marine Exposition to Be Held at the Cen[tral] Mercantile Building, 6th Avenue, Between 18th and 19th Streets, New York City, Nove[mber 14 to 19 Inclusive]

Directory of Exhibits

The American Brass Company, Waterbury, Conn.—Brass, copper and bronze in sheets, plates, wire, rods, bars and tubes; tobin bronze rods and shafting; turbine blading, brass, nickel and bronze, Cupro nickel and monel metal; condenser tubes, Admiralty and Muntz metal; condenser head plates. Booth 75.

American Car & Foundry Company, 165 Broadway, New York.—Berwick electric rivet heater; Berwick electric scarfing heater; Berwick electric rod heater. Representatives: F. C. Cheston, D. B. Wallace, W. M. Earl. Booth 150.

American Engineering Company, Philadelphia, Pa.—35 horsepower electric winch; electro-hydraulic steerer driven by Hele-Shaw pump and controlled by A-E-Co. hydraulic telemotor; Hele-Shaw electro-hydraulic winch; small electric windlass; steering wheels and stockless anchors. Representatives: P. E. Kriebel, D. C. Spencer, E. B. Bryant, C. V. Koons, F. W. Kay, R. C. Lamond and H. Buckholtz. Booths 81 and 96.

American Manganese Bronze Company, Holmesburg, Philadelphia, Pa.—HY-TEN-SL bronze propeller blade; manganese bronze propeller blade; charts of comparative tests on propeller metals; photographs of installations, etc. Representatives: C. R. Spare, T. H. Addie, D. V. Williamson. Booth 63.

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The Crandall Engineering Company, East Boston, Mass.—Photographs, etc., of dry dock installations. Representative: J. Stuart Crandall. Booth 58.

Crane Company, Chicago, Ill.—Complete line of valves and fittings for all types of ships. Representatives: F. C. Bradbury, J. F. Duffy, E. Morgenthal and G. E. Barker. Booths 116 and 147.

Crane Packing Company, 1913 Park Row Building, New York.—Full line of "JOHN CRANE" flexible metallic packings for general power plant use; "JOHN CRANE" process for packing surface condensers so arranged that actual demonstrations regarding the process can be made. Representatives: Julian N. Walton and A. W. Payne. Booth 232.

M. T. Davidson Company, 154 Nassau Street, New York.—"Davidson" vertical marine pumps; "Davidson" patent ash ejector. Representatives: John Lowe, William E. Brennan, William C. Newell, F. O. Kompass, Thos. J. Rogers. Booths 115 and 148.

Diamond Power Specialty Company, 90 West Street, New York.—New "Diamond" automatic rear end front operated soot blower for double and single ended Scotch marine boilers; improved "Diamond" rear end soot blower for single ended Scotch boilers; "Diamond" front end oscillating type soot blower for Scotch marine boilers; "Diamond" model "G" revolving soot blower for watertube boilers; "Diamond" model "E" soot blowing system for hollow staybolt horizontal baffled watertube boilers; new designs of blower heads and operating mechanisms for watertube boiler blowers; an exhibit of calorized metal specimens showing the effect of high temperatures upon iron and steel, and the heat-resisting qualities of soot blower elements made from calorized metal. Representatives: F. W. Leahy, M. Nicholls, F. W. Lambert, Robert June. Booth 158.

The Ellcon Company, 50 Church Street, New York.—White porcelain enameled pipe, anti-slip treads, engine room ladders. Representatives: G. H. Ord, C. A. Koenig. Booth 127.

Fairbanks, Morse & Company, Chicago, Ill.—Two hundred horsepower semi-Diesel direct reversible type C-O engine; 30 horsepower marine generating set. Representatives: D. G. Langlands, Messrs. Drennen, Slingman and Jernberg. Booths 121, 122, 141 and 142.

Foster Marine Boiler Corporation, 111 Broadway, New York.—Literature describing the Foster marine watertube boiler and features such as permanent steel baffles and a metallic cap for closing hand hole openings by a metal to metal joint. Key caps will be shown and a roller tool used in connection with these caps. Representatives: J. J. Nelis, J. C. McKenzie and F. Glander. Booth 190.

General Electric Company, Schenectady, N. Y.—Space used for reception purposes only. Rrepresentatives: S. V. Travis, J. Anderson, L. W. Shugg, H. W. Parsons, C. H. Giroux, A. Kennedy, Jr., W. J. Day. Booth 9.

Great Lakes, Hudson and Atlantic Waterways Association.—Representatives: Charles Ogden, J. P. Gleason, Dr. Henry Moskowitz, Samuel McAukin. Booths 47 and 49.

The Griscom-Russell Company, 90 West Street, New York.—Evaporators, distillers, feed water heaters, fuel oil heaters, oil coolers, grease extractors, strainers and steam separators. Representatives: Robert Colston and A. S. Hoffman. Booths 112 and 151.

Horne Manufacturing Company, Mercer and Colgate Streets, Jersey City, N. J.—Watertight electrical fixtures; circuit breakers; running light indicators; fire alarm thermostats; plugs and receptacles; cargo reflectors; mechanical ships' telegraphs; voice tube fittings. Representatives: L. W. Horne and A. E. Rackliffe. Booth 199.

H. J. Hush, 36 West 60th Street, New York.—Lighterage hoists, pumps, power propelling engines, emergency pumps, D. C. lighting sets. Representatives: J. S. McConville, J. Walsh, H. J. Hush. Booth 21.

International Compositions Company, Inc., 23 Park Place, New York.—Anti-corrosive and anti-fouling compositions and general marine utility paints. Representative: F. W. Petri. Booth 60.

International Mercantile Marine Company, 11 Broadway, New York.—Photographs of vessels of the American, White Star and Red Star Lines. Booths 194 and 195.

Johns-Manville, Inc., Madison Avenue and 41st Street, New York.—Complete line of asbestos products, including refrigerating machine packings, insulations and other power specialties, roofings and building materials. Representatives: H. H. Wesley, J. M. Berdan, B. C. McClure, R. F. Massa, G. K. Bradfield, C. J. Beckwith, F. J. Bryne, C. Rinehart, W. S. Lockwood. Booth 114.

Keasby & Mattison, 217 Broadway, New York.—Working model consisting of coils of piping with various forms of pipe covering; steam will be generated and passed through the model and thermometers and recording devices will indicate the percentage of heat units saved by the various forms of covering over the losses of bare pipe. Representatives: L. L. Barrett, B. U. Livingston, Jr., C. A. Alles and E. F. Kelly. Booth 19.

Kingsbury Machine Works, 4320 Tackawanna Street, Frankford, Philadelphia, Pa.—Kingsbury marine thrust bearings, adjustable and equalizing types; testing machine demonstrating operation; air-lubricated bearing showing complete separation of bearing faces. Representatives: Albert Kingsbury, Nelson Ogden, Paul F. Murphy, J. Frank Cox. Booths 165 and 178.

Lee and Simmons, Inc., 44 Whitehall Street, New York.—Models of covered barge, tugboat, steam lighter, steam hoisting lighter and lighter *Harding*, launched this year; photographs of the various types of vessels used in the lighterage business of the port of New York. Representatives: David T. Lamond, Chauncey Miller, Ryland Palmer, Ralph O. Wilson, Joseph P. Heuer. Booth 12.

The Lunkenheimer Company, Cincinnati, O.—Globe, gate, safety and check valves; oil cups; grease cups; lubricators; oiling devices; whistles, cocks; injectors and engineering appliances in general. Representatives: Walter A. Reynolds, James Cooper, Frank Hyatt, H. Burger, Philip Smith. Booth 149.

Magnesia Association of America, 721 Bulletin Building, Philadelphia, Pa.—85 percent Magnesia pipe and boiler covering; 85 percent Magnesia blocks and locomotive lagging; 85 percent Magnesia plastic, carbonate of Magnesia. Representatives: C. J. Stover and G. S. Stuart. Booth 152.

Marine Decking & Supply Company, Philadelphia, Pa.—Lit-O-Sil-O decking and flooring; Madesco tackle blocks, shackles and sheaves; Madesco paints and varnishes; Madesco "Quaker" cargo hoister. Representatives: W. L. Peebles and G. W. Selby. Booth 200.

Marine Engineering and Shipping Age, Woolworth Building, New York.—*Marine Engineering and Shipping Age, The Boiler Maker,* "Shipbuilding Cyclopedia," "Practical Marine Engineering," "Laying Out for Boiler Makers" and marine books. Representatives: Colonel E. A. Simmons, Henry Lee, C. R. Mills, R. V. Wright, George Slate, F. B. Webster, H. H. Brown, T. G. Newbery, S. M. Phillips, L. S. Blodgett, W. Z. Gardner, H. B. Bolander, H. L. Buhrrus, J. A. Miller, R. F. Duysters, N. C. B. Fowles, J. E. Anderson. Booths 80 and 97.

The Marine News, 26 Water Street, New York.—Files of *The Marine News* and lists of special services. Representatives: Harwood Palmer, H. J. Harding, George Weiss and A. H. Addoms. Booth 198.

The Marine Review, Cleveland, Ohio.—*The Marine Review.* Representatives: V. S. Iden and J. Fuller. Booth 160.

Mercantile Specialties Corporation, 11 Broadway, New York.—"Smithson" safety port holes. Representative: H. G. Mullen. Booth 61.

J. S. Mundy Hoisting Engine Company, Newark, N. J.—Hand steerer; 4½-inch by 6-inch ash hoist. Representatives: C. L. Mundy and C. H. Foster. Booth 184.

The National Malleable Castings Company, Cleveland, Ohio.—Naco anchor chain, shackles, swivels and clinch rings. Representatives: Benjamin Nields, Jr., W. C. Lewis, R. E. Valentine, Floyd Snyder. Booth 161.

New Process Chemical Company, Inc., 114 Liberty Street, New York.—Marine glues; copper paints; bituminous solution and enamels; anti-corrosive and anti-fouling paints; bilge cement; boot topping and topside paints; hull seam composition; canvas waterproof paint. Representatives: Wilder Gutterson, Miss M. E. Granier, August Schlueter, Lew Strawser. Booth 233.

Newport News Shipbuilding and Dry Dock Company, Newport News, Va.—Shipbuilding and ship repairing. Representative: J. P. Kiesecker. Booths 123, 124, 139 and 140.

Northern Fire Apparatus Company, Minneapolis, Minn.—Rotary pump for oil and molasses. Representative: John A. Hense. Booth 228.

O'Beirne Brothers and Lyons, Inc., 319 West 42d Street, New York.—Jarvis oil burner system for ships' galleys. Booth 230.

Albert T. Otto & Sons, Inc. (American representative of Fried. Krupp A. G. Germaniawerft), 101 Park Avenue, New York.—Krupp air compressors. Representative: Stuart Otto. Booth 155.

Pantasote Company, 11 Broadway, New York.—Vehisote panel boards; Pantasote artificial leather. Representative: W. A. Lake. Booth 162.

Peabody Engineering Corporation, 331 Madison Avenue, New York.—Peabody "Fisher" wide range mechanical oil burner. Representatives: J. P. Leask and J. M. Ferry. Booth 154.

Pneumercator Company, Inc., 25 Park Row, New York.—Pneumercator ship's draft gage; tank gages; electric whistle operator. Representatives: Gardner Cornett and Harry S. Parks. Booth 14.

Power Specialty Company, 111 Broadway, New York.—Complete superheater element with core and method of closing hand hole opening in header. Representatives: J. J. Nelis, J. C. McKenzie and F. Glander. Booth 153.

Pyle-National Company, 30 Church Street, New York.—Turbines, turbo-generators, searchlights and fans. Representatives: J. D. Sarles, Carl S. Geis, J. L. Reese and Chas. G. LeFevre. Booth 102.

Row & Davis Engineers, Inc., 90 West Street, New York.—Paracoil evaporators; Paracoil new type feed water heater; Paracoil oil heaters and coolers; RanD system for bunker oil. Representatives: R. R. Row, H. C. Davis and P. O. Kopf. Booth 104.

Scovill Manufacturing Company, Waterbury, Conn.—Seamless brass, bronze, nickel silver and copper tubing; rolling and wire mill products; brass goods. Representative: Philip Davidson. Booth 111.

Shepard Electric Crane & Hoist Company, Montour Falls, N. Y.—Electric winch for ships and piers. Representatives: A. J. Barnes, F. A. Hatch, R. H. McGredy, R. W. Hurst. Booth 126.

The Sperry Gyroscope Company, Manhattan Bridge Plaza, Brooklyn, N. Y.—Sperry helm angle indicator: Sperry electro-magnetic clutch; Sperry continuous speed recorder; Sperry searchlight; Sperry gyro-compass; Sperry gyro-ship stabilizer; Sperry electric log. Representatives: Robert B. Lea, O. B. Whitaker, J. R. Conover, C. D. Johnson and H. A. McDonell. Booth 15.

Stamford Foundry Company, Stamford, Conn.—"Shipmate" ranges. Representative: Frank W. Brant. Booth 226.

B. F. Sturtevant Company, Hyde Park, Boston, Mass.—Battleship and scout cruiser forced draft units; 5 K. W. gasolene engine generating set; 9 by 8 vertical steam engine; turbine for auxiliary pump drive; portable ventilating set. Representatives: Eugene B. Williams, Edward L. Moran. Booths 94 and 95.

Sun Shipbuilding Company, Chester, Pa.—Photographs and models. Representatives: J. T. Borden and J. W. Hudson. Booths 76, 77, 100 and 101.

The Superheater Company, 17 East 42nd Street, New York.—Model of the Elesco fire tube superheater as applied to the Scotch marine type of boiler; model of the Elesco superheater as applied to marine watertube boilers and boilers used on river boats; steam pyrometer for measuring steam temperatures; Elesco boiler feed pump. Representatives: George C. Fuller, Adolph Starr, George E. Kershaw, Walter L. Lovekin, H. B. Oatley, George L. Moore, W. E. McLintock. Booth 72.

The Texas Company, 17 Battery Place, New York.—Samples of marine lubricants. Representatives: Frank J. Shipman, D. P. Quinn, J. L. Ward, H. W. Salbador, A. St. James, W. W. Hoopes, H. W. Schilling, E. A. Lobb, L. O'Malley. Booth 105.

P. S. Thorsen & Company, Inc., 81 Coffey Street, Brooklyn, N. Y.—Insulation of steam pipes and boilers. Representatives: P. S. Thorsen and A. Wood. Booth 113.

W. & J. Tiebout, 118 Chambers Street, New York.—Brass and galvanized ship hardware. Representative: John Tiebout, Jr. Booth 10.

Todd Shipyards Corporation, 25 Broadway, New York.—Models to scale of a modern ocean liner and the big six-section floating dry dock, known as No. 4, in the Robins yard. The model of the dock measures 11 feet 6 inches overall. *Tietjen & Lang Company, of Hoboken, N. J.,* and *Tebo Yacht Basin Company of Brooklyn:* scale models of a 750-horsepower Diesel marine engine with electric drive, 13 feet in length, and a turbine with gearing in position in the engine room of a steamship; model of an oil-burning fruit and passenger liner, 12 feet overall. *White Fuel Oil Engineering Corporation:* section of an oil-fired Scotch boiler and also the very latest improvements in oil burning equipment, including the new Todd burner. Representatives: J. S. Milne, William H. Raab, H. Nightengale. Booths 119, 120, 143 and 144.

United States Navy.—*Construction and repair:* Submarine *Holland,* submarine *S-1,* submarine *S-2,* submarine *S-3, Miantonomah, Cheyenne, Vermont* (old), *Vermont* (new), *South Carolina, Oklahoma, Pennsylvania, Shubrick* and *Decatur,* destroyer *Sampson,* one box of label plates, 1 stand for radio outfit, smoke helmet, gas mask. *Ordnance:* 3"/50 gun, antiaircraft; 3"/50 mount, antiaircraft; Lewis machine gun and tripod; Browning machine gun; Colt machine gun; mine and anchor; 3"/50 cartridges, dummy charge; for anti-aircraft gun; set of cartridges, 1-pdr. to 4"/50 (dummy powder charge); set of projectiles, target, 5-inch to 10-inch; set of dummy charges for above; 5-inch powder tank; 12-inch powder tank; 14-inch powder tank; range finder 1½-meter on tripod; mark XIV telescope; stadimeter; set dummy bombs; bomb sight; 21-inch torpedo. *Bureau of Engineering:* 2-kilowatt arc set; ½-ton kilowatt spark set; CW936 telephone, with loud speaker; receiving set with vacuum tube detector, amplifier and crystal detector with head telephones and battery for spark set. *Bureau of Navigation:* Paintings of heroic deeds, citations, photos showing recreational, athletic, educational and hygiene work; map of third naval district, showing piloting cable, radio station, etc. *Marine Corps:* Lewis machine gun complete; Browning machine gun, complete; Colt machine gun, complete; trumpets; slings, trumpet, dress; drum; carriage drum stick; sticks, drum, rosewood, pr.; haversack; carrier, pack; pouch, meat can; tents, shelter half; flags, rectg. red, large; flags, rectg. blue, large; guidons, USMC, silk; shoes, field, pr.; helmets, trench; respirator, gas, complete; canteen; cover, canteen, O.D.; can, meat; knife; spoon; flags, signal, 2-foot red; flags, signal, 2-foot white; flags, signal, 4-foot red; flags, signal, 4-foot, white; sling, drum, dress; flagstaffs, 3-lengths; flagstaffs, 2-lengths; rifle, Browning automatic; sling, straps, for; pistols, cal. 45; holsters, pistol, cal. 5 FL.; rifles, cal. 30, model '03 (1 for V.B. grenades); slings, 1903 model, rifle, web; bayonets, 1903 rifle; heliograph; discharger, rifle, grenade V. B. Mk. III; grenades, rifle, dummy V. B. Mk. I; grenades, hand, dummy, V. B. Mk. I; cutters, wire, intrenching; arm chest; chevron boards; German war map; German auto tank gun. *Bureau of Aeronautics:* Liberty motor and propellers. Representative: Michael D. Schaefer. Booths 1, 2, 3, 4, 5, 6, 7, 8, 66, 67, 68, 69, 70, 71, 106, 107, 108, 109 and 110.

United States Shipping Board.—50-foot model of 535-foot passenger and cargo steamer, full sized model of standard stateroom and other features of Shipping Board activities. Booths 50, 51, 52, 53, 54, 55, 56 and 57.

Valentine Company, 456 Fourth Avenue, New York.—Valspar varnish; Valspar varnish stains; Valspar enamels. Representative: Dorning Walker. Booths 64 and 65.

Victor Engineering Company, Philadelphia, Pa.—Victor steam jet ash ejector (model and full sized machine). Representatives: Eugene Hahn and C. L. Bachman. Booth 191.

Wager Furnace Bridge Wall Company, Inc., Singer Building, New York.—Wager patent bridge wall for Scotch marine and watertube boilers. Representatives: Louis F. Fenwick and Alexander Halley. Booth 117.

Wailes-Dove-Hermiston Corporation, 17 Battery Place, New York.—Bitumastic and hermastic bituminous compositions; bitumastic colored paints. Representatives: Linden Stuart and others. Booth 137.

Elisha Webb & Son Company, 136 North Front Street, Philadelphia, Pa.—"WebbperfectioN" marine cooking and lighting apparatus. Representatives: Elisha Webb, Jr., and James Hampton Webb. Booth 59.

Western Union Telegraph Company, 195 Broadway, New York.—Booth 39.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.—Model reduction gear; radiophone demonstration; motion pictures. Representatives: W. H. Easton, D. D. Faris, N. R. Sibley, G. H. Jaspert, W. E. Martin, C. C. MacMillan. Booths 78, 79, 98 and 99.

C. H. Wheeler Manufacturing Company, Philadelphia, Pa.—Single stage Radojet air pumps; double stage Radojet; intercondenser Radojet; Navy type condensate pumps; dynamometers for testing Diesel engines; also accessories to the above. Representatives: C. H. Lang, M. J. Mullan, J. Dobson. Booth 13.

The D. T. Williams Valve Company, Cincinnati, Ohio.—Marine valves; regrinding globe, angle and check valves; gate valves; cocks and fittings in medium and extra heavy types; lubricators; oil and grease cups, steam traps, etc. Representatives: Chas. J. Clark and H. J. Frincke. Booth 183.

C. A. Woolsey Paint & Color Company, Jersey City, N. J.—Copper paints, marine paint specialties; spar varnish. Representatives: Percy Varley and E. D. Kelly. Booth 62.

Worthington Pump & Machinery Corporation, 115 Broadway, New York.—Centrifugal and steam pumps. Some rather new and novel designs of centrifugal boiler feed and circulating pumps. Representatives: M. L. Katzenstein and W. A. Cather. Booth 146.

New Devices Exhibited at the Marine Exposition

Locking Device for Stockless Anchors

THE stockless anchor locking device produced by the American Steel Foundries, Chicago, described in detail on page 602 of the August issue of MARINE ENGINEERING AND SHIPPING AGE, will be exhibited with other products of this company at the Marine Exhibition.

Valspar Varnish Combined With Transparent Color

THE Valentine Company, New York, will exhibit a new product—a combination of Valspar varnish and transparent color, known by the term "Valspar varnish stain," at the Marine Exposition. These stains are in six different shades, mahogany, walnut, light oak, dark oak, cherry and moss green. Valspar varnish has certain heat and water resisting qualities and it is claimed that the new varnish stains have the same properties. The use of the stain is intended to eliminate the necessity of first staining a surface and then varnishing it to get the required finish.

Steam Nozzle Takes Place of Pump in New Type Ash Ejector

AN ash ejector, which is operated by a specially designed steam nozzle with a consequent reduction in steam losses, has recently been produced by the Victor Engineering Company, Philadelphia, Pa. A special feature of the ejector due to the absence of a pump is that the danger of flooding the boiler room is eliminated.

In operating the mechanism a single stroke only is necessary to turn on the steam, open the seagate and uncover the hopper, while a single return stroke will reverse the operation. The ash hopper on the ejector is considerably reduced in size so that it is kept level with the floor. This hopper will receive clinkers up to 5 inches before they enter a 6-inch pipe. Complete details of the apparatus will be published in a later issue of the magazine.

Marine Lighting and Ventilating Apparatus

THE Pyle-National Company, Chicago, will exhibit a new combination search and flood light, and a portable ventilating turbine fan among other equipment at the Marine Exposition.

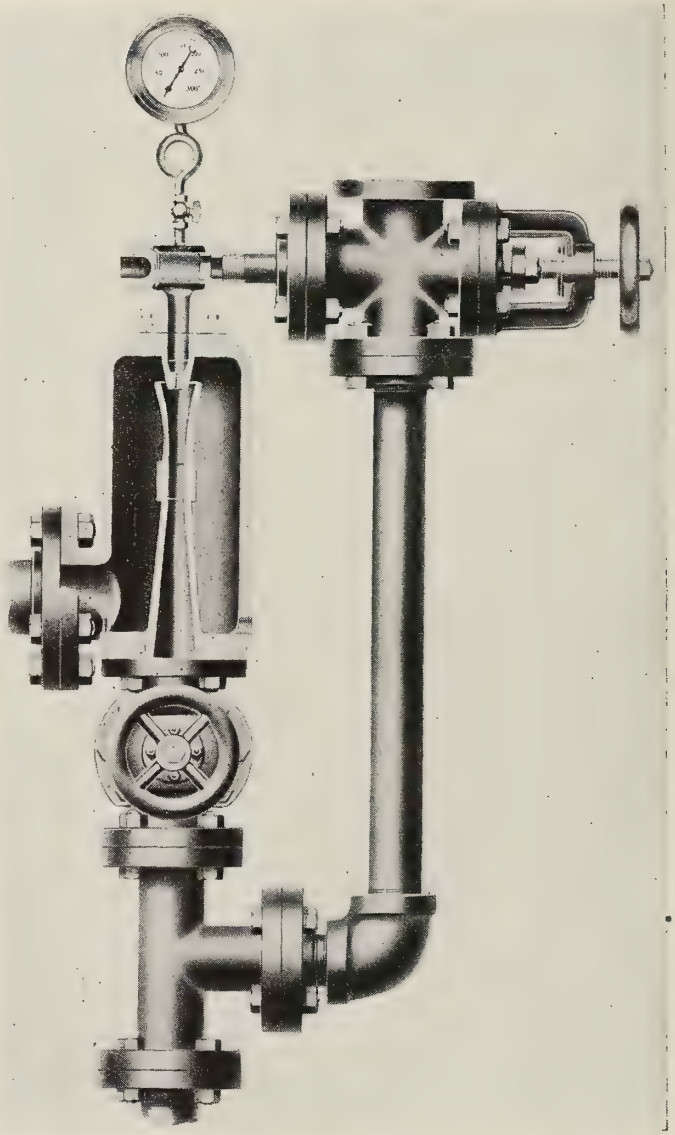
The combination search and flood light was given a series of tests in the Erie Canal service to determine whether or not navigation on the canal could be made safer at night. Because of a wide flood ray of light through which a powerful beam is projected, showing a boat 800 to 1,000 feet away, the new light has been found useful for this service. It is claimed that local harbor and river navigation is made easier and that time is saved in landing by the use of this light. This combination light is supplied with or without a pilot house control.

The Pyle-National Company has also applied small type steam and air driven turbines manufactured by the company to ventilating and exhaust fans especially designed to eliminate gases in oil tanks and in other service where a portable fan can be operated.

Apparatus Designed to Increase Evaporator Efficiency

DURING periods of reduced capacity the efficiency of evaporators drops and to overcome this the Griscom-Russel Company, New York, has designed a device known as the G-R regenerative compressor which will be shown at the Marine Exposition.

Efficiency in an evaporator depends on the pounds of distilled water produced per pound of steam in the coils of the evaporator. The regenerative compressor boosts the efficiency by compressing and delivering to the evaporator coils a portion of the vapor taken from the evaporator. This vapor, together with a certain amount of boiler steam, makes up the total steam required for evaporaor operation; otherwise this total steam would have to be supplied by the boiler. Latent heat that would ordinarily be wasted overboard in the distiller or condenser circulating water is thus made use of in the compressor to increase the efficiency.



Regenerative Compressor Used in Connection with Evaporator

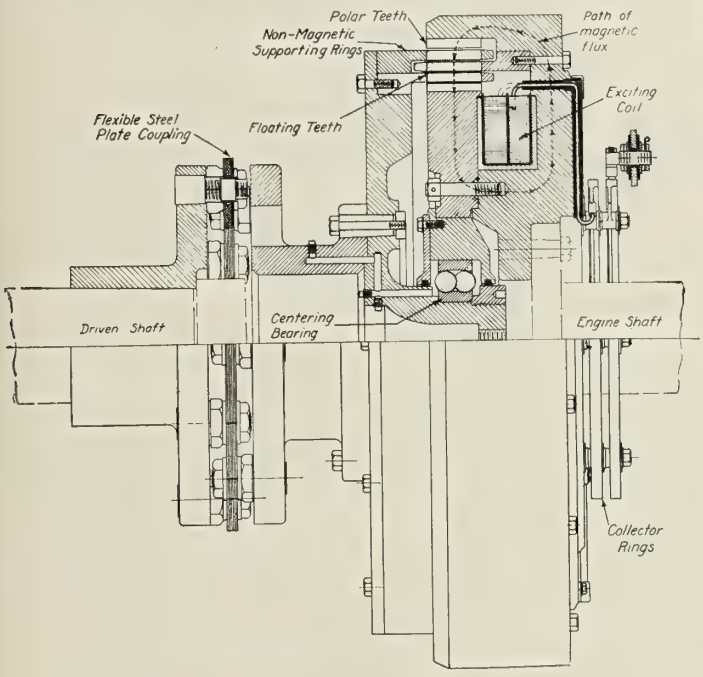
Sperry Develops New Devices for Ship and Engine Control

IN addition to the regular products of the Sperry Gyroscope Company, Brooklyn, N. Y., with which marine engineers and naval architects are in general familiar, this company will exhibit at the Marine Exposition a new type Sperry helm angle indicator, a Sperry electo-magnetic clutch and a Sperry continuous speed recorder.

The helm or rudder angle indicator shows at all times the exact position of the rudder of the ship and acts as a visible check on the rudder-operating mechanism. Two types of instruments have been developed, one of which, the rudder angle indicator, is used to meet naval specifications. Both instruments have the indicator hand directly connected to the shaft of a self-synchronous direct current 110-volt motor which is controlled by a transmitter connected to the rudder stock. The naval type rudder indicator is provided with face markings and indications in units of 1 degree up to 5 degrees on either side of the center and from 5 to 35 degrees indications are given in units of 2½ degrees. The merchant marine type of instrument is provided with dial readings conforming to standard practice in merchant marine terminology; that is in units of 2½ degrees up to 10 degrees and from 10 degrees to 35 degrees in units of 5 degrees.

Magnetic Clutch Coupling

The Sperry type of magnetic coupling or clutch was developed as a result of several years' experiment with electric



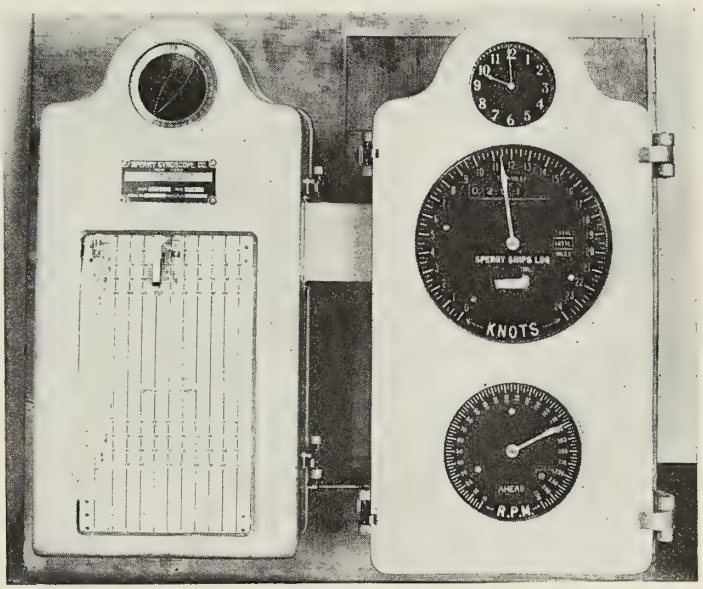
Details of Magnetic Clutch Coupling

transmission for automobiles. For marine use it is adapted to transmit power from Diesel or oil engines, to operate air compressors, to connect synchronous alternating current motors to their load and tandem connected alternating current generators to their source of power. It is built in a large range of sizes and used to provide a flexible self-alining clutch for power transmission. The half coupling, carrying floating teeth, is ordinarily centered by a sleeve or ball-bearing projection from the opposite half of the coupling. This centering projection maintains a normal condition of the air gap and prevents exterior forces due to shaft mis-alinement or other conditions disturbing the proper relation of the coupling parts. The energizing coil of the coupling consists of a single circular coil of relatively large size wire which is wound in a form and impregnated with Bakelite.

The standard couplings are designed to be operated at a potential of 110 volts direct current, although exciting coils may be wound for any voltage up to 500. The clutch is energized by the pressing of a button, and the driven part is gradually speeded up and brought into synchronism with the driving part. After the clutch is synchronized no slipping takes place unless a load is thrown on the clutch greatly exceeding its rated capacity.

Continuous Course and Speed Recorder

The continuous course and speed recorder, developed by the Sperry Company is run from the gyro-compass and



Continuous Course and Speed Recorder

is an improved type electric log to give visual indications of the actual speed, desired speed, trip mileage and average propeller revolutions. This device also makes permanent records on a graph paper running for a period of sufficient length to cover an entire month's record showing exact compass courses maintained and any variance due to the quartermaster's steering ability.

Electrical Fixtures for Marine Service

TO prevent the stealing of electric lamps and brass guards aboard ship the Horne Rim-Lok guard for watertight electrical fixtures has been developed by the Horne Manufacturing Company, Jersey City, N. J., to clamp the guard to the fixture base. This guard is not threaded, but fitted with a groove that snaps over a projecting rim on the fixture. When locked, the guard cannot be pulled off, but still it is free to turn. The looseness of the fit between the guard and the fixture overcomes the effect of corrosive action experienced in types where the guard is screwed in place. The new type guard can be unlocked and removed regardless of the length of time that it has been in service.

New Type Reflector

A new development of cargo reflectors or light clusters, adapted to use a single nitrogen lamp of 750 watts capacity, will also be shown at the Exposition. It is claimed that the candlepower shed by this reflector, known as the Horne "Nitrolite," is more than double that of a 6-light cluster of 60-watt lamps. Three different styles of frames are used, one to concentrate the light rays directly downward, another to concentrate the light rays in a horizontal direction and a third to shed light rays downward in every direction except

upwards. This latter type is used to advantage during construction and repairs in shipyards and dry docks for illuminating closely confined spaces and holds.

Automatic Running Light Indicator

The Horne automatic running light indicator or marine tell-tale indicator is arranged with removable panels for each running-light circuit so that any panel may be removed for repairs without interference with other circuits. The indicator has a three-pole switch on each panel which is normally thrown to conform with No. 1 lamp; upon failure of this lamp the reserve, or No. 2 lamp, is automatically thrown in circuit by the relay. Simultaneously the indicator lamp on the tell-tale board is lighted, a buzzer is sounded and a further visual signal is given by means of a radium-lettered indicator card attached to the relay armature. Thus three distinct warning signals are provided which remain evident until the switch is thrown to conform with No. 2 lamp which has been temporarily placed in circuit.

A new Horne "Fuze Klip" circuit breaker to be inserted between standard fuse clips has been developed for use in place of refillable fuses. When a circuit is overloaded the new circuit breaker opens the circuit; then to re-establish the circuit it is only necessary to reset the breaker. The copper and carbon contacts of the breaker have the proper carrying capacity, and the arc is snuffed out by a magnetic blow-out coil.

Canada Wins Fishermen's Trophy

IN two one-sided races on October 22 and 24 the Canadian speedy fishing schooner *Bluenose* regained for the Halifax fishing fleet the North Atlantic fishermen's cup won last year for the United States by the *Esperanto* of the Gloucester fleet.

The American defender this year was the *Elsie*, a vessel that in preliminary elimination trials had proved herself the speediest of the Gloucester fleet. She was a smaller vessel than the *Bluenose*, however, and although a fast contender while reaching in the lighter breezes, she was unable to match the close pointing and driving power of her rival in windward work. The *Bluenose*, built in a Lunemburg yard after designs by W. J. Roue, was sailed by Captain Angus Walters. The *Elsie* was handled by Captain Marty Welch who won the cup for the United States a year ago with the *Esperanto*.

Bluenose the Faster Boat

The first race was marred by an accident when the fore topmast of the *Elsie* was carried away which put the American defender hopelessly out of the race. The second race was sailed without mishap or error and proved conclusively that the Canadian boat was too strong for its opponent. The superb handling of both vessels at all times fully upheld the time-honored traditions of the North Atlantic fishing fleets and added lustre to the well-earned reputation of these hardy seafarers for seamanship and sportsmanship.

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Fishing Schooner Elsie, of Gloucester, Chosen to Defend the Silver Trophy Won Last Year by United States Fishermen in Competition with Canadian Fishermen

New Cunard Liner Scythia

England's Latest Type of Ocean Liner, The Scythia

Among a number of foreign steamship companies which are constructing passenger liners to meet the world's shortage of this type of vessel, the Cunard Line stands predominant with contracts for twelve new liners, the last to be delivered by the end of next year. These vessels will all be of the intermediate type and will include five of 20,000, *one of* 16,700, *and six of* 15,000 *gross tons. The Scythia is the first of the* 20,000 *ton ships to be completed and is the largest Cunarder built since the war.*

THE new liner *Scythia*, which left Liverpool August 20 for her initial run in the Cunard passenger service between New York and Liverpool, represents the latest type of intermediate passenger liner especially designed to meet general post-war shipping conditions.

Not only is the *Scythia* the largest new Cunarder built since the war, but she is up to the present the largest passenger carrying vessel on the Atlantic especially designed and built to burn fuel oil and possessing propelling machinery of the latest double reduction geared turbine type. Various new features have also been introduced in her passenger accommodations, several of which appear for the first time on a Cunarder of her size. Among these are included the garden lounges for saloon, veranda cafe for second class and the numerous two-berth cabins for third class passengers.

The new *Scythia* is the second vessel of this name to be operated by the Cunard Company and a comparison of this modern vessel with the former one conveys an idea of the remarkable progress made in the science of naval architecture in the past fifty years.

First Scythia

The first *Scythia* was a vessel of 4,556 tons and was built on the Clyde. She was a vessel 432 feet long with a beam of 42 feet 6 inches, a depth of 36 feet and contained four decks and seven watertight compartments.

Accommodation was provided for 300 first class and 1,000 second and third class passengers.

Great interest was aroused at the time of her first voyage because of the fact that a new method of lighting, consisting of the American sperm oil lamp, was used for the interior of the ship and that the saloons and sleeping apartments were fitted with electric bells communicating with the stewards' pantry.

The Modern Scythia

The new *Scythia* represents the latest practice in the science of building ships and belonging as she does to the intermediate type of vessel is roomy, steady and of moderate speed. She was built in the yards of Vickers, Ltd., Barrow-in-Furness.

An attempt has been made to provide the greatest possible comfort in passenger accommodations and the furniture of her large public rooms and staterooms has been specially designed with this end in view.

The principal characteristics of the vessel are as follows:

Length, over all	625 feet 0 inches
Length, between perpendiculars	600 feet 0 inches
Breadth, molded	73 feet 6 inches
Depth, molded to "D" deck	45 feet 0 inches
Depth, keel to top of funnel	140 feet 0 inches
Draft, loaded	30 feet 5 inches
Speed, average sea	16 knots
Gross tonnage	20,000 tons
Displacement	27,000 tons

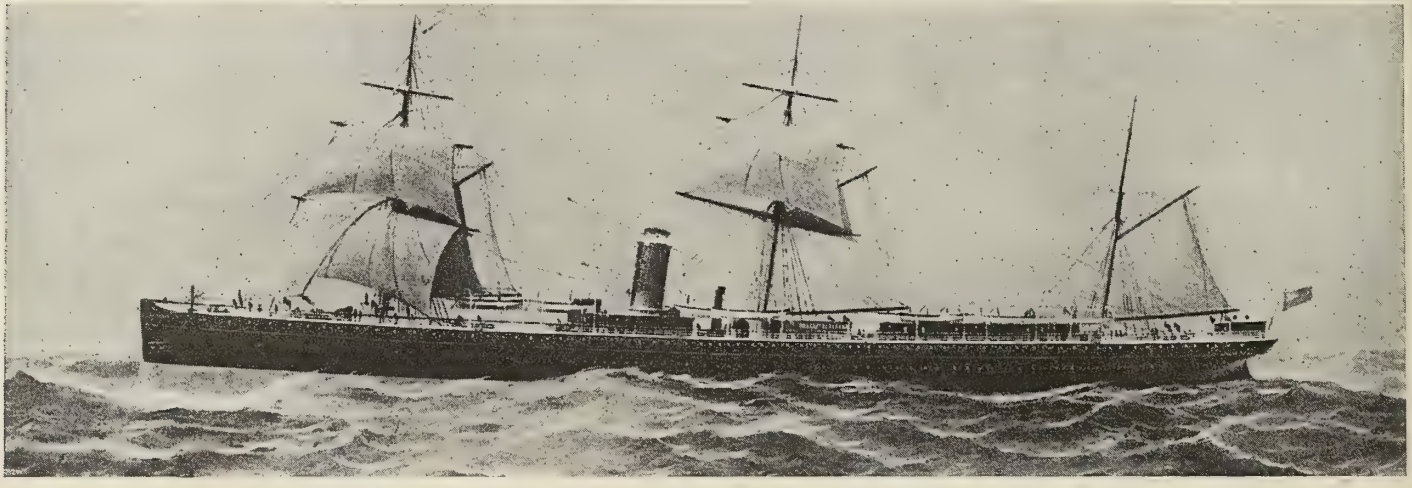
The vessel is classed 100-A1 at Lloyds, shelter deck with freeboard, special survey, and will meet the requirements of the British Board of Trade and American authorities in all respects as a passenger vessel.

Careful consideration was given the watertight subdivision of the vessel and in this respect the regulations of the International Convention of Safety of Life at Sea have been met. There are eight decks and a double bottom which has been carried well out up the bilge.

Where doors are fitted in watertight bulkheads, provision has been made for operating either by hand or by the Stone-Lloyd hydraulic power system, all arrangements being such that the operations may be controlled from either side of the bulkhead or from the navigating bridge.

Above the bulkhead deck the vessel is divided by fire screen bulkheads in such a manner that in the event of fire in any portion of the ship that particular part can be isolated from the rest of the vessel by closing the fireproof doors in the fire screen bulkheads bounding that compartment, thus preventing the fire from spreading to other parts of the ship.

The actual extinguishing of the fire is accomplished by the use of carbon dioxide which is stored in cylinders and operated on the Gronwald system. A good supply of fire hydrants and hose is also provided.



The First Scythia, of 4,556 Tons, Built on the Clyde in 1875

Accommodations

Provisions have been made aboard the *Scythia* for accommodating 337 first class, 331 second class and 1,538 third class passengers and a crew of 409, making a total accommodation for 2,615 persons.

Every endeavor has been made to provide the greatest possible comfort for the passengers and the furniture of the large public rooms and staterooms has been specially designed to this end. The decoration of her accommodations represents the work of artists and craftsmen of the greatest skill and each public room with its furniture and appointments forms a complete picture in which everything has been worked out to the smallest detail.

New features are continually being introduced in the modern liner which tend to increase the comfort of the passenger. One of these is the garden lounge. In the *Scythia* saloon passenger accommodations there are two garden lounges, one situated on the port and the other on the starboard side of the "A" or promenade deck. Here passengers may enjoy the sun and sea air among surroundings typical of an old English garden fitted with many comfortable wicker chairs. Large sliding glass windows are fitted in the side of the vessel in way of the garden lounges and add to the comfort of this space by providing means for shutting out cold winds and rain.

The main staircase leads to an imposing central hall with approaches to the saloon, drawing and writing room, lounge and smoking room. This grouping of the public rooms should prove of great convenience to passengers.

The lounge is particularly attractive. In plan it is oval with an imposing central dome of white glass. There are four alcoves diagonally opposite each other and the massive fireplace and marble mantlepiece is surmounted by a picture in the style of the period. The furniture and the appointments of the room present a most attractive color scheme in black and gold, grey and gold, with here and there touches of vermillion, the rich effect being toned down by a number of pieces of furniture in old mahogany. The coverings are in black and gold and blue and gold with charming Chinese designs, while grey velvet is also introduced into the scheme. Chinese silk of blue and gold is the material used for the curtains while a reseda green pile carpet completes the successful effort to provide a general representation of the best work produced during the latter part of the eighteenth century.

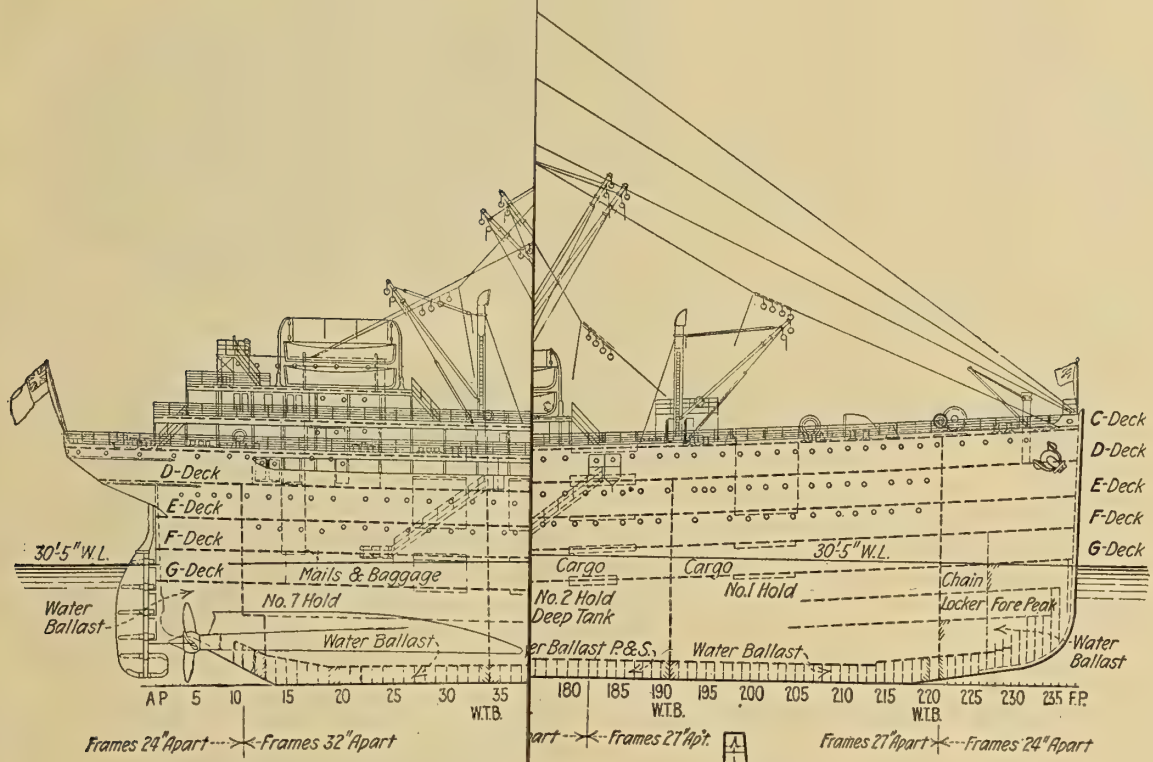
The drawing and reading room is extended at each end athwartships by an alcove and the main feature of this room is the elliptical dome for the center portion finishing with a fan shaped painted panel on either side. The color scheme of the walls and ceiling is white while the appointments are in the modern style, but showing an influence of the Georgian period. The Adam furniture is of dull old mahogany and the silk coverings form a unique color scheme of purple and yellow. An open fireplace adds a sense of comfort to the room and opposite this there is a handsome carved mahogany bookcase.

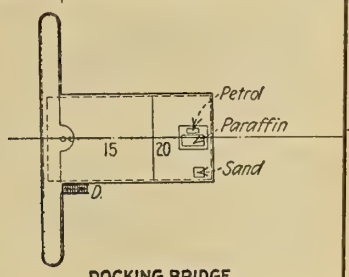
The smoking room is a cozy compartment consisting of a center room with a coach top roof and two side wings. Its furniture is of the plain Chippendale type with Chinese fretted detail. Large settees and easy chairs are covered in a reproduction of an early English, eighteenth century version of Chinese tapestry. The room is panelled throughout with antique oak.

The dining saloon for the use of first class passengers is situated on the "E" deck. It extends the full width of the ship for a length of 64 feet. Walls and ceilings are treated in white decorated plaster and in the center is a richly decorated, pierced dome. Behind this dome is the musician's gallery. The long tables of the past have given way to small tables with portable four legged chairs which are now so popular among travelers and at which 2, 4, and 6 people can sit. A number of small sideboards are situated in convenient places and a large oval buffet is located in the center from which cold dishes can be served.

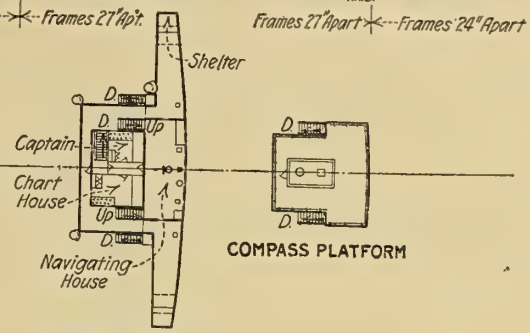
The first class staterooms are fitted up in a particularly

ENGLCYTHIA



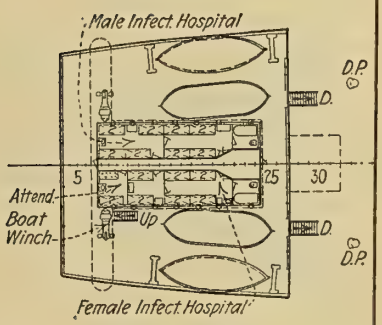


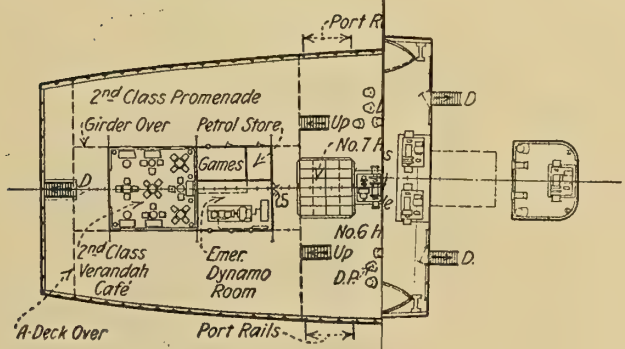
DOCKING BRIDGE



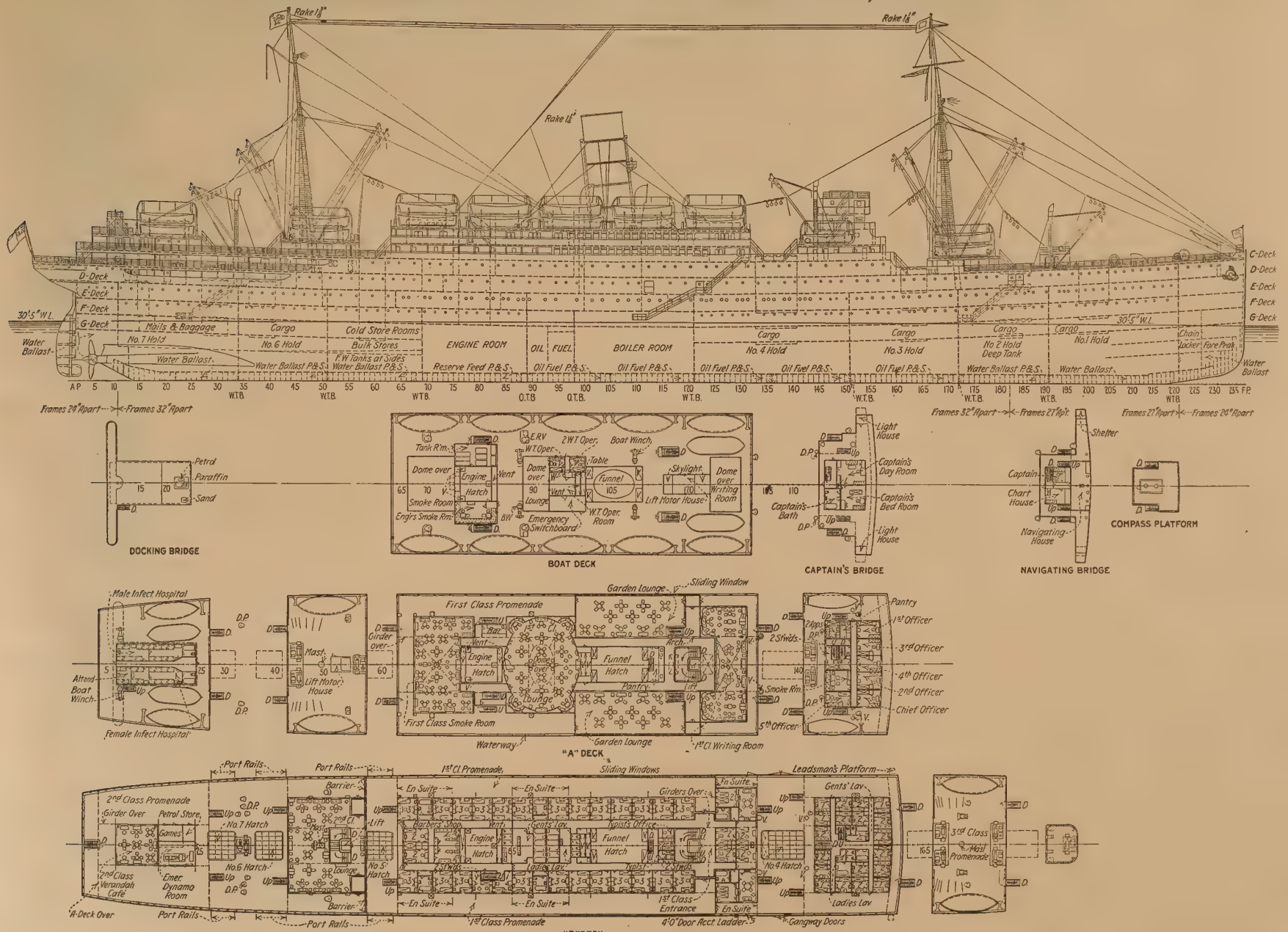
NAVIGATING BRIDGE

COMPASS PLATFORM





ENGLAND'S LATEST TYPE OF OCEAN LINER, THE SCYTHIA



Profile and Deck Plans of 20,000-Ton Cunard Liner Scythia

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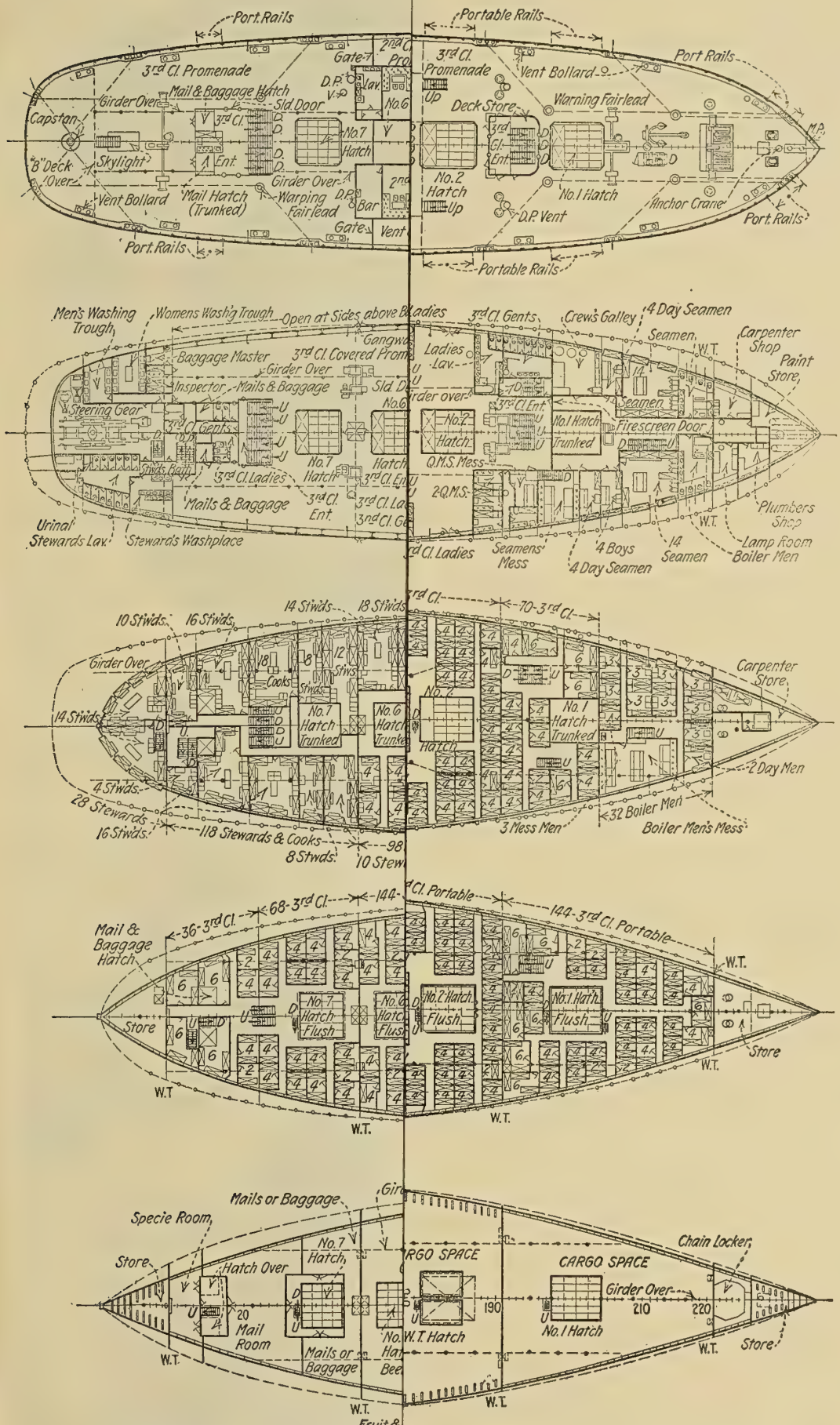
Port Rails
Portable Rails
3rd Cl. Promenade
Mail & Baggage Hatch
Girder Over
Capstan
"B" Deck Over
Skylight
Vent Bollard
Mail Hatch (Trunked)
Warping Fairlead
Gate
Port Rails
Portable Rails
Deck Store
Warning Fairlead
No. 2 Hatch
No. 1 Hatch
Anchor Crane
D.P. Vent
Men's Washing Trough
Womens Wash'g Trough
Open at Sides above Bulwarks
Ladies
3rd Cl. Gents
Crew's Galley
4 Day Seamen
Seamen
Carpenter Shop
Paint Store
Baggage Master
3rd Cl. Covered Prom.
Inspector
Mails & Baggage
Steering Gear
Ladies Lav.
Firescreen Door
Q.M.S. Mess
2 Q.M.S.
Plumbers Shop
Lamp Room
Boiler Men
Urinal
Stewards Lav.
Stewards Washplace
Seamens Mess
4 Boys
14 Seamen
10 Stwds.
16 Stwds.
14 Stwds.
18 Stwds.
70-3rd Cl.
Carpenter Store
Cooks
4 Stwds.
28 Stewards
16 Stwds.
118 Stewards & Cooks
98
8 Stwds.
2 Day Men
3 Mess Men
32 Boiler Men
Boiler Men's Mess
36-3rd Cl.
68-3rd Cl.
144
144-3rd Cl. Portable
Store
W.T.
Mails or Baggage
Specie Room
Chain Locker
CARGO SPACE
Girder Over
Hatch Over
20 Mail Room
190
210
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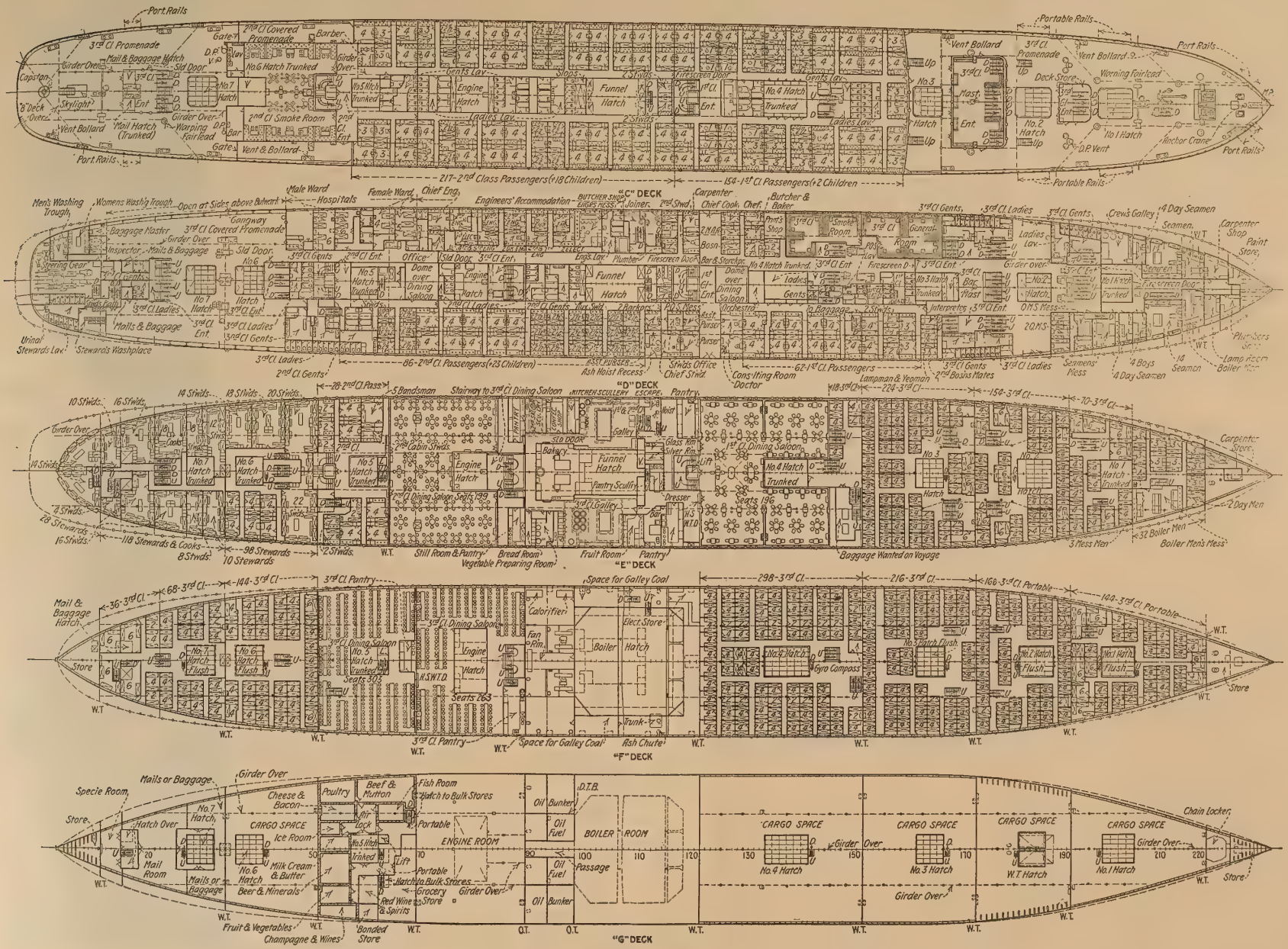
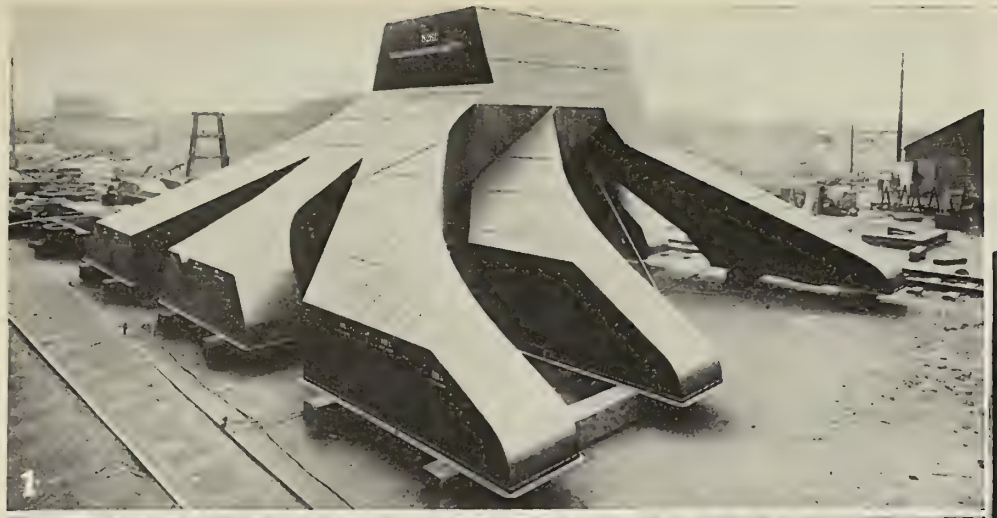
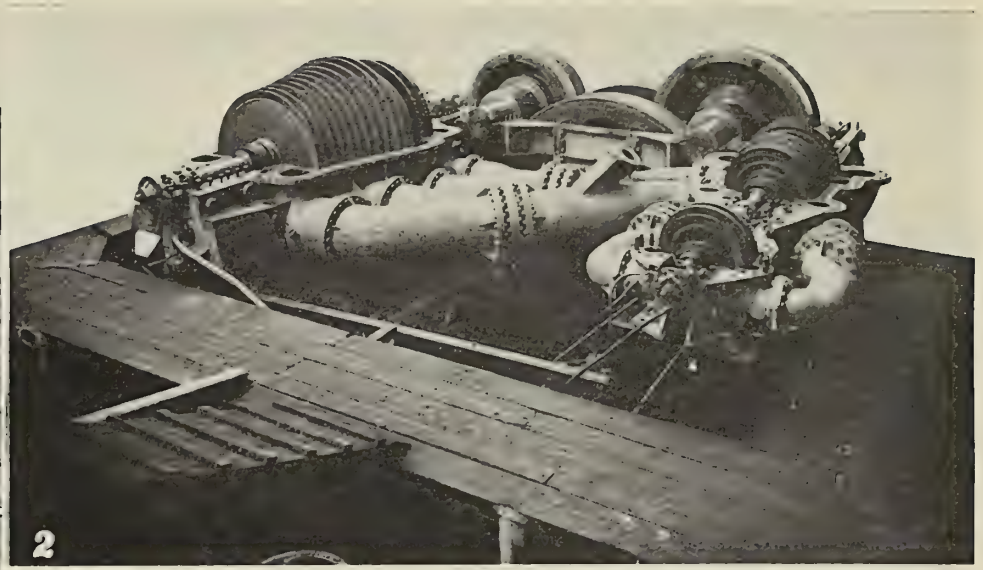
Fruit &

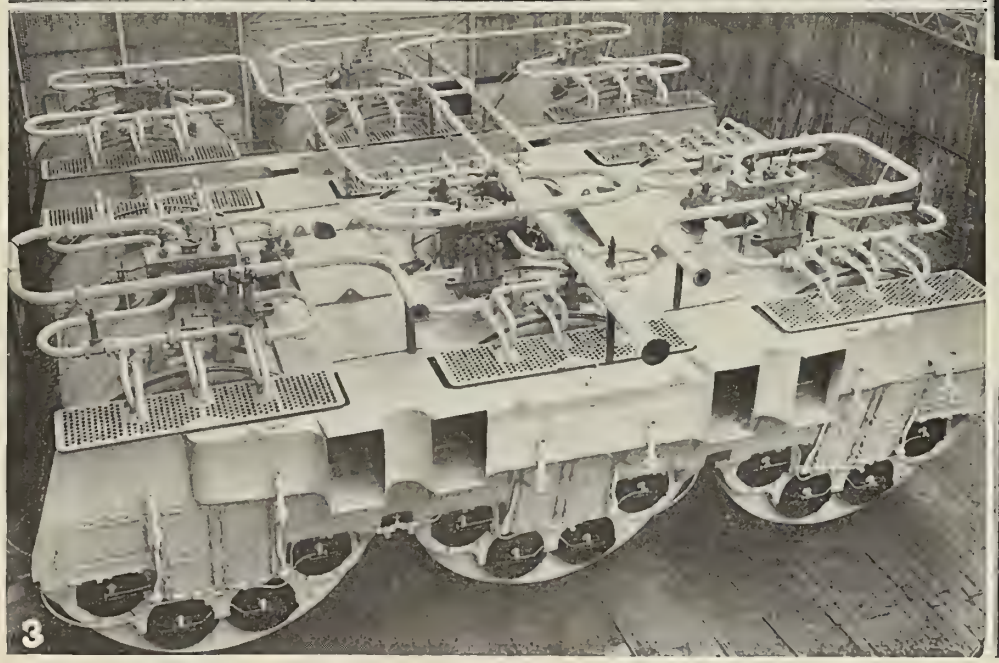
ENGLAND'S LATEST TYPE OF OCEAN LINER, THE SCYTHIA

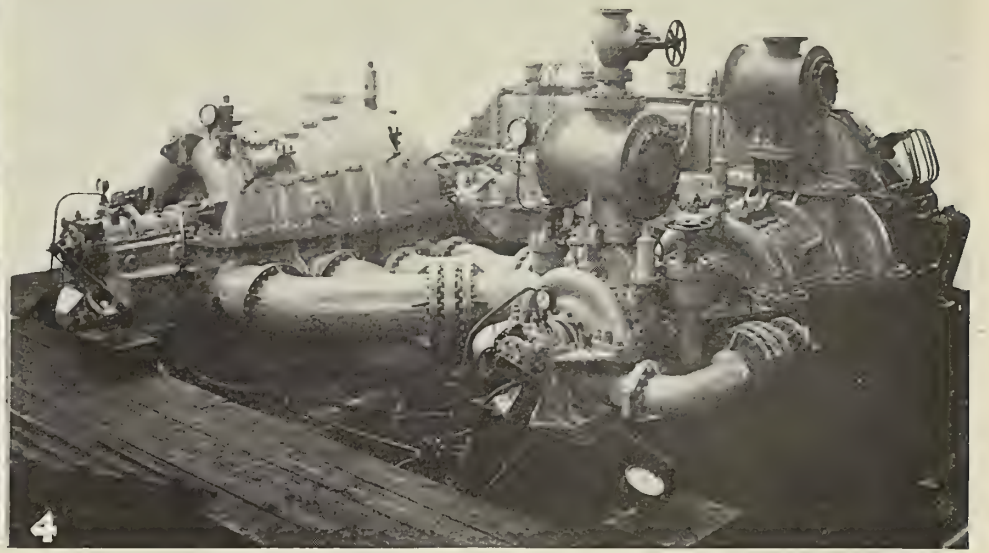


Deck Plans of 20,000-Ton Cunard Liner Scythia









(1) Arrangement of Uptakes for the Laconia, Which Is a Sister Ship to the Scythia. (2) Steamship Scythia, Double Reduction Geared Turbine Unit with Top Housing Removed, Showing Turbine Rotors and Gears. (3) Boiler Installation for the Laconia, Sister Ship to the Scythia. (4) Steamship Scythia, Double Reduction Geared Turbine Unit

Cunard Liner Scythia: (1) First Class Dining Saloon. (2) First Class Lounge. (3) Reading and Writing Room. (4) First Class Garden Lounge and Veranda Cafe. (5) Suite de Luxe Sitting Room. (6) First Class Smoking Room. (7) Suite de Luxe Bedroom.

attractive manner, those on the promenade deck having wooden beds for two people with a Pullman berth which, if necessary, can be made to accommodate a third person. The furniture of these rooms is of carved mahogany and each room is fitted with hot and cold running water.

There are two private suites located forward on the "A" deck. Each comprises a sitting room, bed room, bath and vestibule. The decorative scheme is in the Louis XVI style and the color scheme of the sitting room is of green and gold while the bedrooms are treated in French grey and white. Ingeniously contrived fittings provide a large amount of wardrobe space while the rooms are free from loose furniture. These suites are so arranged that if necessary they can be entirely cut off from the general accommodation of the ship.

There are also a number of staterooms which can be booked en suite with bath.

Second Class

In that part of the ship devoted to second class passengers the comfort of the traveler has received the fullest consideration. Public rooms include a dining saloon, lounge and smoking room. In the dining saloon small tables for 4 and 6 people are provided and the oldtime sideboard has given way to a number of small quick service tables. The drawing room is finished in plain mahogany and the smoking room is panelled throughout in oak and furnished also in oak with moquette coverings of modern design. A veranda cafe overlooks the stern of the vessel thus giving the passengers an uninterrupted and sheltered view of the sea.

Third Class

Never before on any ship has such care been devoted to the design and accommodation of third class passengers. The old fashioned open berths have been entirely dispensed with and throughout the ship third class passengers are berthed in commodious rooms which accommodate two to four persons.

What is true of the third class accommodation is also true of that provided for the crew.

Ventilation and Heating

The holds are ventilated by natural and the passenger accommodations by mechanical means. The thermo tank system is employed for third class rooms whereby a supply of ordinary fresh air or heated fresh air can be supplied to any compartment or cabin with means of regulating at will by the passenger. In addition, cabins, corridors and public rooms are fitted with radiators.

Galleys and Refrigerating Compartments

As the total number of persons carried will be 2,615, culinary arrangements have been made on a very generous scale and will include many electrically driven labor saving devices such as silent mincing machines, potato peeling and potato mashing machines, revolving dough mixing machine, bread slicer, dish washing machines, knife cleaning machines, electric hot plates, griddle plates, toasters, etc., in addition to the usual cooking ovens, steam ovens, steam cookers, boilers, bread provers, hot presses, etc. A separate galley and cooking arrangements are provided for the crew.

An extensive system of refrigerating chambers is provided on "G" deck allowing for the carriage of perishable food such as beaf, mutton, poultry, fish, milk, butter, etc., and kept at the required temperature by the electrically driven CO_2 refrigerating machinery situated in the engine room. The insulation of the refrigerated compartments consists of Delta slab cork and composition as embodied in the J. D. patent unit system of insulation. This insulation is fireproof, vermin proof and, on account of its hard and smooth finished surface, easily washed. The thicknesses of insulation required with this system are less than would be required with the old system of granulated cork, silicate cotton or charcoal, and in addition to requiring no repairs the upkeep costs are said to be negligible.

Life Saving Appliances

The life saving appliances have had all the attention that this important subject demands. Forty-two lifeboats are provided, which are sufficient to carry every individual aboard. These boats are handled by Welin quadrant davits, insuring quick handling of the boats, and in addition there are six electro-hydraulic boat winches which may be operated by current from the emergency motor driven generator situated on one of the upper decks. This generator can also supply current for the wireless, lighting and steering gear in the event of the main electric generators being out of action through accident.

Electro Hydraulic Power

The arrangements for handling cargo, maneuvering the ship and working cables comprise the very latest systems, namely, variable speed gear winches, capstan and windlass on the electro-hydraulic principle, which have been designed and installed by the shipbuilders.

Some of the features of the system may be summarized as follows: abolition of steam and exhaust pipes which are difficult to arrange in the ship and which cause heating and often leakage, most objectionable, particularly in passenger ships; fuel saving, as the steam winch is a very extravagant user of steam and as the power derived from an economical dynamo saves this steam and accordingly fuel; immediate availability, in that no time is lost in warming up steam pipes and also that in the event of the vessel requiring to be warped while steam is off the boilers, current can be derived from the emergency dynamo previously mentioned; silence through the absence of heavy reciprocating parts. Among the electrical advantages are the following: the electric starter is a simple apparatus seldom operated and in working there are no controller contactors subject to wear from sparking nor is there any danger from fire or heating due to large resistances between decks as in most ordinary electrical winches.

The rudder is operated by a Brown Brothers electro-hydraulic steering gear.

Two sets of turbo-driven generators of 375 kilowatts each are provided for supplying electric current for the various electrical equipment throughout the vessel.

Main Propelling Machinery

The main propelling machinery consists of turbines of the Brown Curtis type which drive twin screws through double reduction gearing. The machinery and boilers have been constructed to the requirements of the Board of Trade, Lloyds and American survey, and are capable of developing a collective shaft horsepower of 12,500 with the revolutions of the propeller shaft about 80 per minute. Provision is made on the high pressure turbines for the fitting of additional nozzles so that the shaft horsepower may be increased to 13,500.

The total power when working astern is about 70 percent of the ahead power. The turbine will operate with steam at 220 pounds per square inch with 200 degrees of superheat.

The main machinery comprises two sets of steam turbines, each set consisting of one high pressure and one intermediate pressure turbine in tandem, driving one primary pinion, and one low pressure turbine driving the other primary pinion of the gearing.

Astern turbines are incorporated in the casings of the intermediate pressure and low pressure ahead turbines, adjusting blocks of the Michell type being fitted.

The gearing is of the double helical type and the shaft bearings for the turbine and gearing are arranged to work under forced lubrication.

Thrust blocks of the Michell type are fitted on the main

shafts next to the gearing to take up the propeller thrust.

The condensers are of the underslung type bolted direct to the low pressure turbines so that the low pressure turbine is always free from drainage water. All the latest improvements for economical and efficient operation in conjunction with the feed heating system are embodied in the vacuum system.

The main shafting is made of hydraulic forged ingot steel finished bright all over and drives propellers of the built-up type, each consisting of four manganese bronze blades secured to a propeller boss of cast steel.

Boilers

The steam generating installation consists of three double-ended and three single-ended Scotch boilers arranged in one compartment and constructed to Board of Trade and Lloyd's requirements for a working pressure of 220 pounds per square inch. The boilers are of the multitubular return tube type fitted with smoke tube superheaters and Howden's forced draft. The mean diameter of all the boilers is 17 feet 6 inches; the mean length of the double-ended is 22 feet 6 inches and of the single-ended 11 feet 6 inches. Each double-ended boiler is fitted with eight furnaces of the Morison suspension type and eight separate combustion chambers; the single-ended boilers having four furnaces and four separate combustion chambers. Steam flue blowers are fitted to each combustion chamber.

The forced draft system includes two pairs of single inlet fans electrically driven, one motor being arranged to drive two fans.

The boilers are designed for burning oil fuel, but the fronts are arranged for quick conversion from oil burning to coal.

Auxiliary Machinery

The auxiliary machinery of the vessel includes the following:

Three forced lubricators for supplying oil to the turbine bearings and gearing.

Two circulating pumps of the centrifugal type, driven by horizontal spindle impulse turbines.

Three feed pumps including one turbo-driven and two of the direct-acting type; the two direct-acting pumps together, and the turbo pump alone, being capable of supplying the boilers at full power.

Two 50-ton evaporators with automatic feed and brine ejector. The evaporators are arranged for working singly or in series.

One distiller capable of distilling 50 tons per 24 hours.

One bilge pump of the vertical duplex type.

One emergency bilge pump driven by gearing and shafting connected to an electric motor.

One sanitary or wash-deck pump and one bilge pump, arranged at the forward end of the gear case on each main engine.

One sanitary and wash service pump, electrically driven rotary type.

Two ballast pumps; one of the duplex type, and one motor driven.

One washing water pump of the duplex type.

One fresh water pump of the duplex type.

Two fresh water filters fitted with connections from the discharge of the fresh water and washing pumps.

One auxiliary centrifugal pump driven by a single-cylinder vertical engine of the forced lubrication type.

One oil fuel transfer pump.

One oil bilge well pump.

Two electric ash hoists.

Operating Data

The firetube superheaters in the boilers of the *Scythia* are designed to deliver steam at 600 degrees Fahrenheit at the throttle under the gage pressure of 200 pounds per square inch. This gives the steam approximately 200 degrees superheat. Under normal operating conditions, the engines of the *Scythia* will develop 13,000 shaft horsepower, giving a service speed of 17 knots. As in the case of most vessels, however, the first two runs of the *Scythia* have been made at comparatively low speeds to properly work in all bearings and afford an opportunity to tune up the engines and boilers. On her last Atlantic crossing she maintained an average speed of 14.1 knots with the engines indicating 8,000 shaft horsepower turning at 70 revolutions per minute. For this speed the boilers and superheaters were required to deliver steam at 500 degrees Fahrenheit. The fuel consumption for the run was 95 tons of oil per day or at the rate of about 1.106 pounds per shaft horsepower per hour. Further details of the operating records of the *Scythia* will be available after her return voyage to this country, on which she will be tested under the severest service conditions.

Are You a Shipping Man, á la Edison?

(*Concluded from page* 807.)

63. How much tonnage tax does an American vessel have to pay annually?

64. Where are marine mortgages recorded?

65. What are the American Marine Insurance Syndicates?

66. Why does an iron vessel last longer than a steel vessel?

67. What is a ship's husband?

68. What is the tonnage of the Type A, Hog Island ships?

69. What famous vessel did Captain Samuel Samuels command?

70. What American yacht won the last International yacht race?

71. Where is the yacht *America* now?

72. Where is the famous old warship *Constitution?*

73. To what does section 34 of the so-called Jones Act relate?

74. What confederate cruiser destroyed a great many American merchant vessels during the Civil war?

75. What United States vessel sank her?

76. Name four of the old established and prominent American shipyards?

77. Who built the *St. Louis* and the *St. Paul?*

78. Who built the *Korea* and *Siberia?*

79. Who built the *Mongolia* and *Manchuria?*

80. Where was the liner *Minnesota* built?

81. What American-built steamship holds the round trip record for the North Atlantic?

82. What is the basis of a nautical mile, or knot?

83. How does the speed of a vessel vary in proportion to the propulsive power applied?

84. What vessels are required by the Government to be equipped with radio apparatus?

85. Name three leading American marine insurance companies.

86. What do freight vessels, making a trip light, usually carry for ballast?

87. How are lighthouses distinguished at night?

88. How are buoys lighted?

89. What is a bell buoy?

90. What effect has shoal water on the speed of a vessel?

91. What is a derelict?

92. What are the two principal classes of derelicts, and what branch of the Government destroys or removes them?

93. What are the functions of the Coast and Geodetic Survey?

94. What cabinet officer has charge of that service?

95. Where is Scotland light, and for what was it named?

96. Why do not sailing vessels go through the Straits of Magellan?

97. What regulated the size of Shipping Board vessels, known as "Lakers"?

98. What light vessel is first picked up by steamers coming from Europe to New York?

99. Why are double bottoms used in merchant vessels?

100. Where, in this country, can the *Leviathan* be docked?

U. S. S. Tampa, the First Electrically Driven Coast Guard Cutter

First Electric Coast Guard Cutter Completed

Tampa, One of Four Revenue Vessels Placed in Service by Treasury Department, Has Successful Trial

OFFICIAL sea trials of the U. S. S. *Tampa,* the first of a series of four electrically propelled Coast Guard cutters to be placed in service by the Treasury Department, have recently been completed off the Pacific Coast with entire success.

The *Tampa* was built by the Union Construction Company, Oakland, Cal., and the electrical apparatus was furnished by the General Electric Company, Schenectady, N. Y. She is 240 feet long, with a beam of 39 feet, a depth of 25 feet 6 inches and a displacement of 1,600 tons at a mean draft of 14 feet. Her contract speed of 16 knots was exceeded during the trials, as her average speed over the measured mile was 16.3 knots.

The main propelling equipment consists of two Babcock & Wilcox oil burning watertube boilers supplying steam at 200 pounds gage pressure and 50 to 75 degrees superheat to a Curtis turbine direct connected to an alternating current generator supplying electric power to a 2,600 horsepower synchronous motor giving a propeller speed of 130 revolutions per minute.

The control equipment consists of a control group and a panel, so arranged that it can be operated either electrically or, in case of an emergency, by hand. Two exciters, one being a spare unit, furnish current for the excitation of the generators and synchronous propulsion motor and also power for driving various auxiliaries, such as the blower motor, steering gear, the gypsy, radio apparatus, refrigerating plant, laundry and lighting equipment.

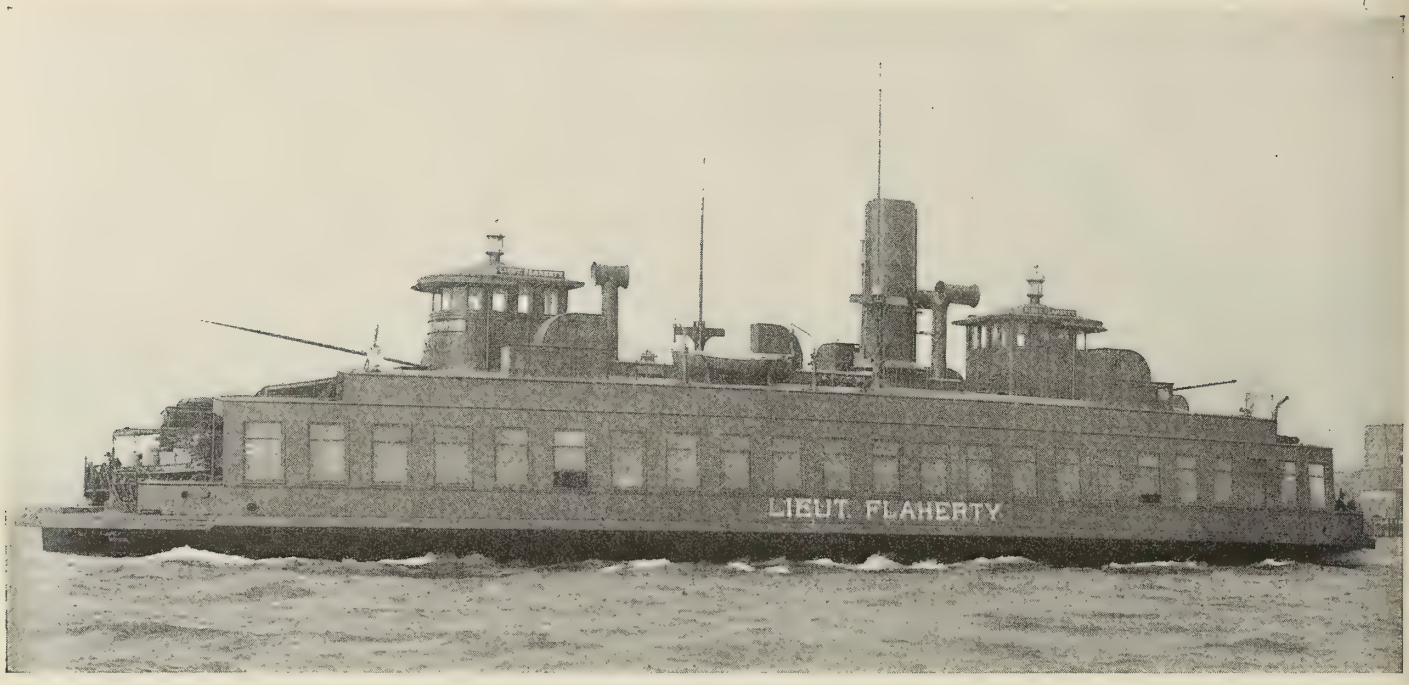
"One of the most noticeable features of the full power trial," says the *Coast Guard Bulletin,* "was the absence of effort on the part of any of the operating personnel. Practically all of the machinery lubricates itself automatically, and it is necessary only to keep an eye on gages, thermometers, etc., and assure that all parts are functioning properly.

"While the boilers installed in the *Tampa* appear to be small, the power developed by the propelling machinery was 2,900 shaft horsepower throughout the trial, and the safety valves were blown about every half hour simply to show that it could be done and that the boilers furnish more than enough steam for all the requirements of the ship.

"The operating gear consists of the same two levers with which we have been familiar for several generations—one for speed control and the other for direction—and any man who is capable of 'backing and filling' with a reciprocating engine can, without additional instructions, operate the new machinery with equal facility.

"It is confidently expected that the propelling machinery of these ships will not call for even slight repairs or adjustment over a period of years."

GEORGE WASHINGTON TO MAKE MEDITERRANEAN CRUISE.—The Shipping Board has voted to carry out the contract made by the United States Mail Company with Raymond & Whitcomb by which the *George Washington* will make a tour through the Mediterranean beginning in February and returning to Cherbourg in March or April.



One of the New Boston Ferryboats

New Ferryboats for Boston Harbor

Two Single-Deck Passenger and Vehicle Steamers Built for East Boston Ferry—Each Boat Has Four Driveways

THE two new ferryboats of the four-driveway type recently put into service in Boston harbor to run between Boston and East Boston will add considerably to the traffic facilities in this port. That two boats so especially well fitted for the service and so thoroughly up to date were acquired was due to the efforts and foresight of Boston's Commissioner of Public Works, Mr. T. F. Sullivan.

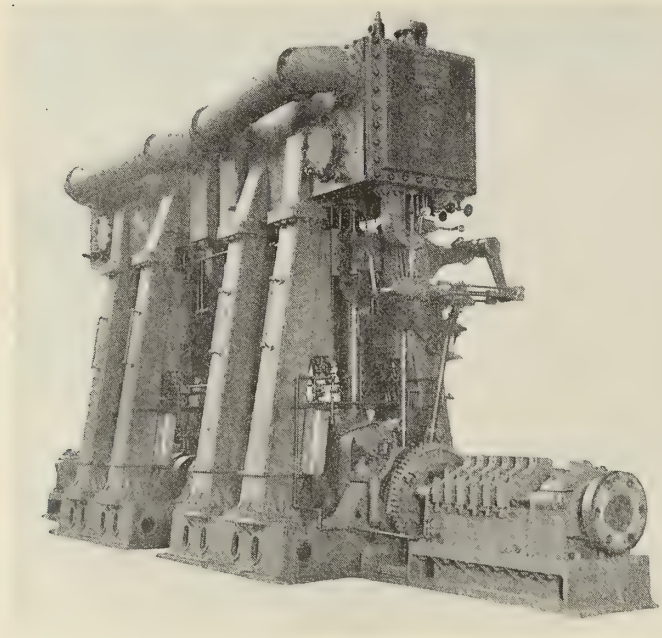
These vessels, which are named *Lieutenant Flaherty* and *Ralph J. Palumbo,* were designed by Fay, Spofford & Thorndike, consulting engineers, Boston. Associated with them were A. B. Raymond and A. L. Swasey as naval architects. Owing to other duties Mr. Swasey withdrew and the design and construction were carried out under Mr. Raymond's personal supervision. The contract for the machinery installation was awarded to the Kearfott Engineering Company, Inc., 95 Liberty Street, New York, who acted as consulting engineers for this portion of the work and were responsible for several ideas entering into its design.

The *Lieutenant Flaherty* was built at the yards of the Groton Iron Works, Groton, Conn., and the *Ralph J. Palumbo* at the plant of the Winnisimmet Shipyard, Inc., Chelsea, Mass.

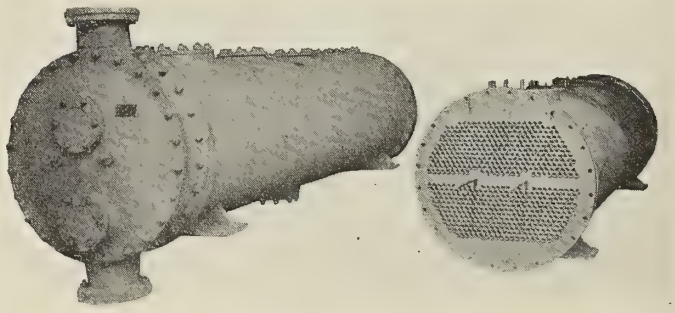
General Arrangement

The main deck of each vessel is arranged to provide four driveways, two of which are located on each side of a very narrow central monitor and on each side of the vessel outboard of the driveways there is provided a cabin for the accommodation of the foot passengers with a single row of seats extending along the inboard bulkhead.

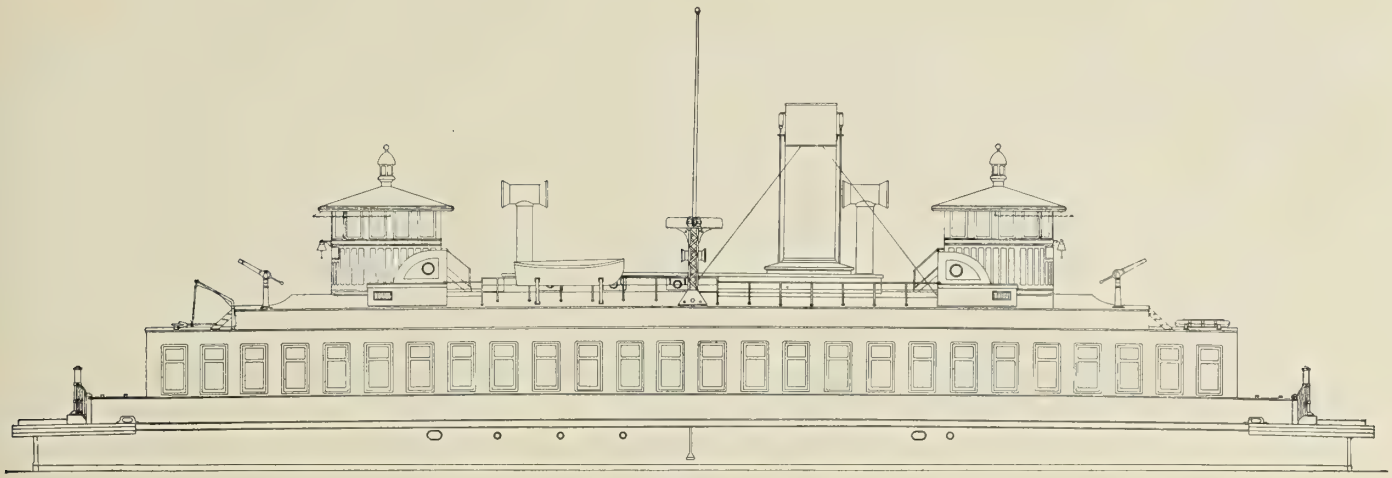
The vessels are primarily of the single deck type of ferryboat, but the deck overhead which covers the driveways and



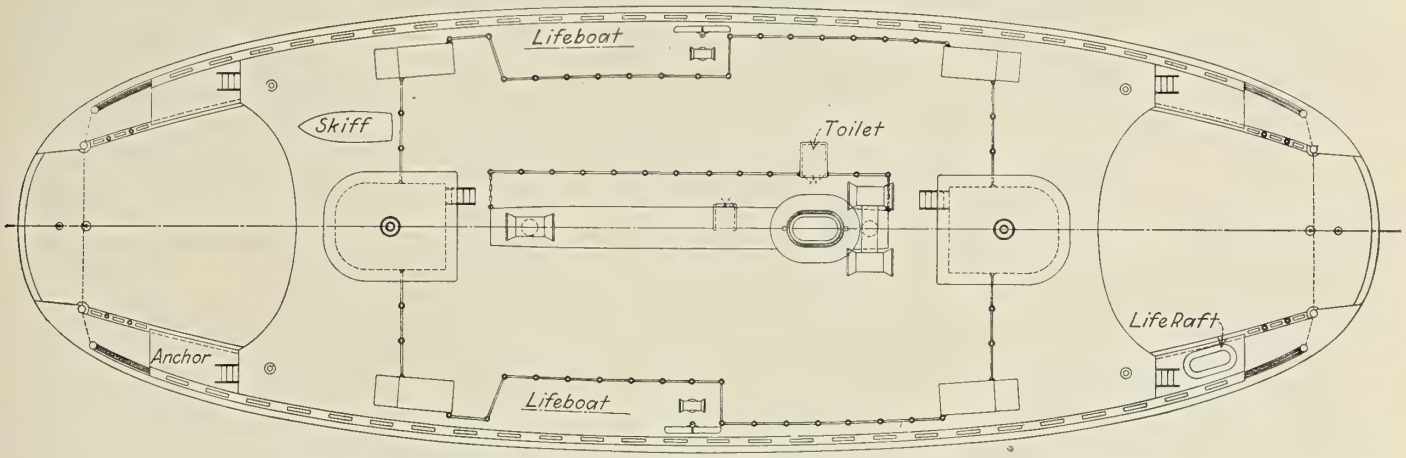
Main Engines



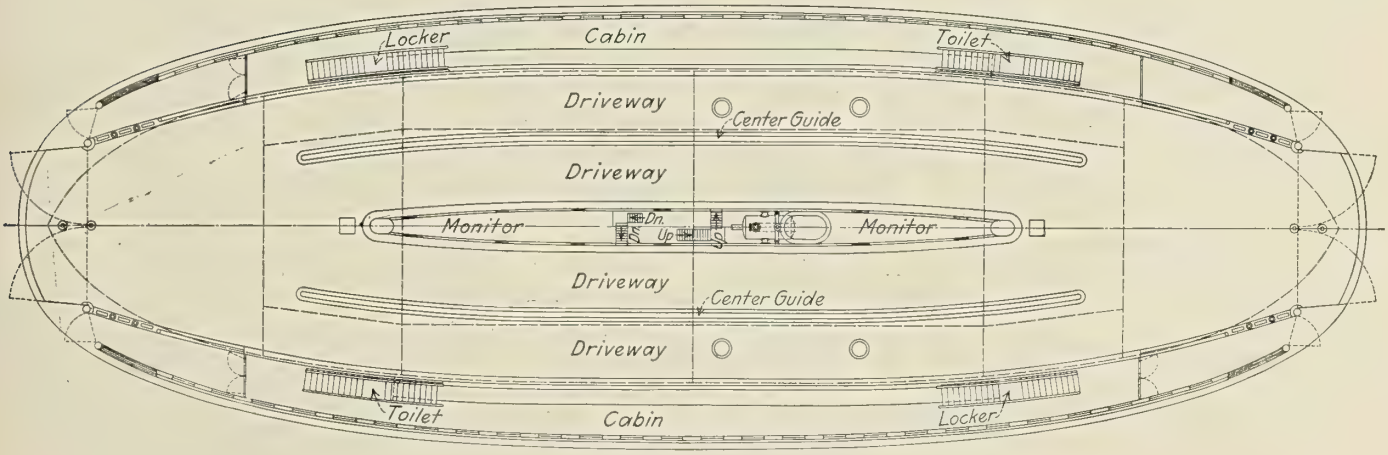
Main Condenser



OUTBOARD PROFILE



UPPER DECK



MAIN DECK

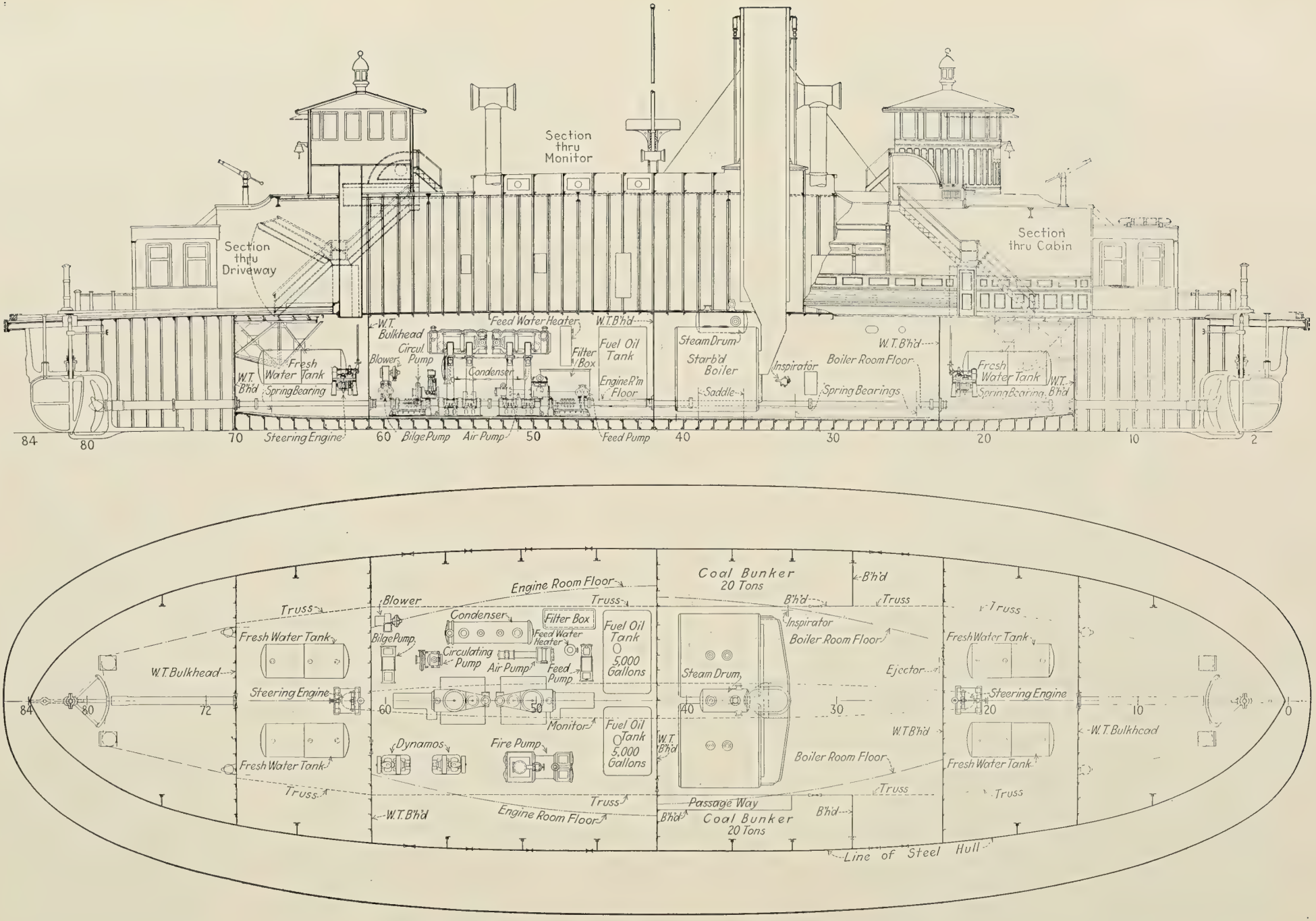
Outboard Profile and Deck Plans

passenger accommodations is arranged so that it may be used to accommodate the overflow when conditions of heavy traffic so require. In this connection an ingenious installation of hinged stairways is provided to afford access to the upper deck. In ordinary circumstances these stairways are hinged up and supported under the deck overhead, but may be readily lowered when desired. The construction and equipment of the vessels meet all requirements of the United States Steamboat Inspection Service.

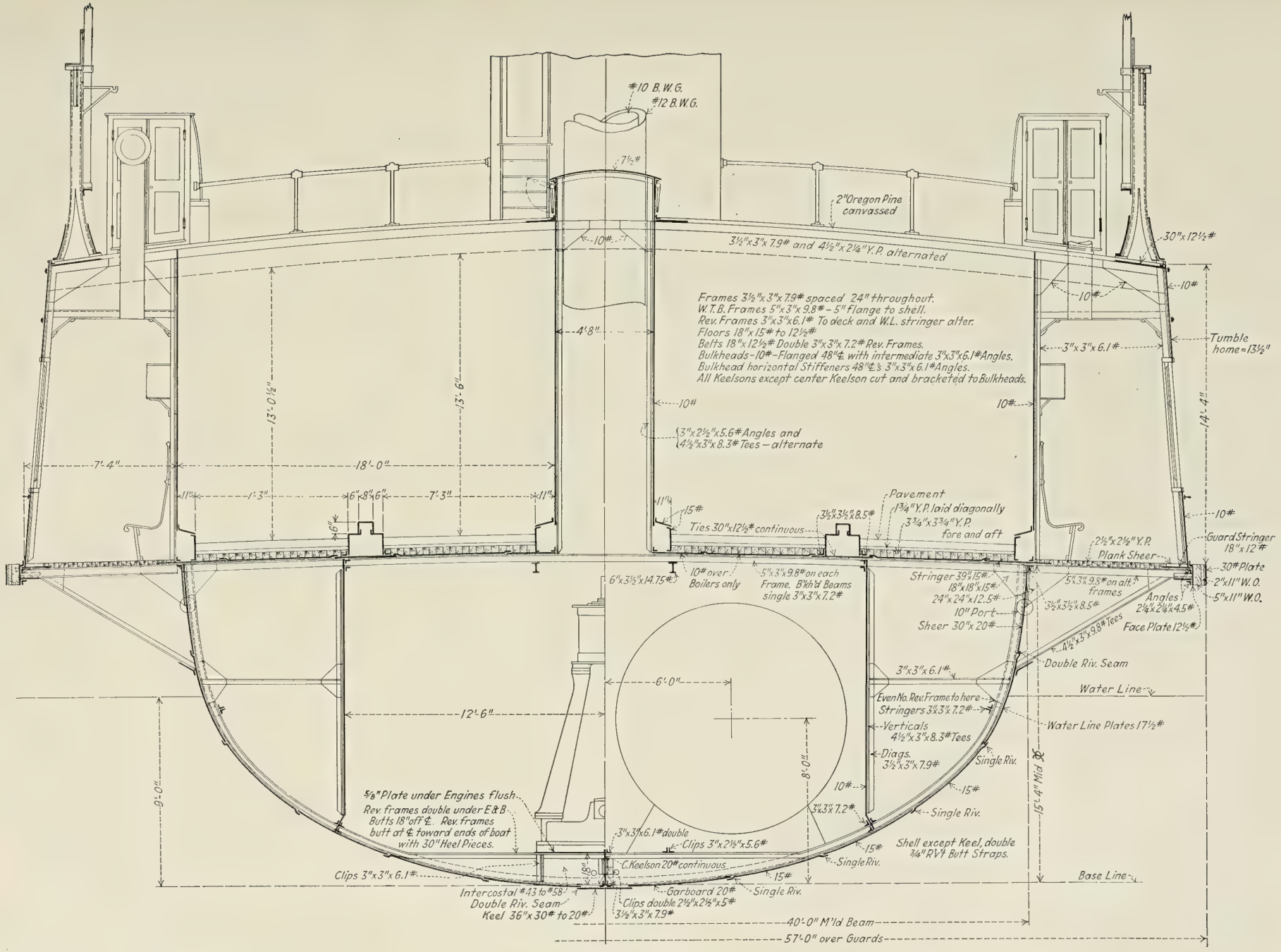
The principal dimensions of the ferryboats are as follows:

Length over all	174 feet
Length outside to outside of propeller posts	146 feet 6 inches
Beam, extreme over guards	57 feet
Beam, hull, molded	40 feet
Depth, molded	15 feet 4 inches
Draft with water and fuel	9 feet

There are two longitudinal trusses, one on each side of the vessel which serve to distribute the load and add to the longitudinal strength. They are built up with 4½-inch by 3-inch ties, set vertical and 3½-inch by 3-inch crosswise angles connected by gusset plates to continuous tie plates.



Inboard Profile and Hold Plan, Showing Machinery Arrangement



Midship Section

The framing is transverse, spaced 24 inches center to center.

The driveways are decked with yellow pine, laid over 10-pound plating in way of the machinery space. On top of this a pavement of the patent Shuman type is laid, which is made up in slabs using oak, rock elm, maple or other hard woods. These slabs run the full width of the driveways and are about 6 feet long. They are made up of continuous stringers with the grain running athwartship, alternating with blocks arranged with the grain running vertical. The blocks and stringers are cemented together with hot liquid asphalt and in addition are bolted together with through bolts ⅜-inch in diameter, there being three bolts to each section. These slabs are spiked to the deck and afterwards painted with a heavy coat of liquid asphalt applied hot and a layer of stone dust ½-inch thick spread over the surface.

Machinery

The propelling machinery consists of two vertical inverted, compound type engines, each having a 15-inch diameter high pressure cylinder, a 30-inch diameter low pressure cylinder and a common stroke of 22 inches. The crank shafts of the engines are coupled together by flanges on the high pressure ends and compose the center section of a shaft running the length of the boat and driving the two propellers, one at each end of the vessel. The engines are controlled by a common throttle valve and maneuvering has been provided for by flanging the ends of the link crank shafts together, a single reversing engine taking care of both engines. The two propellers, always working in unison, one as a tractor and the other as a propeller, according to the direction of rotation, are of cast steel, with an outside diameter of 7 feet 6 inches and a pitch of 10 feet 6 inches.

The engines for the vessels were built by the Vulcan Iron Works, Jersey City, N. J., under contract from the Kearfott Engineering Company, Inc. The shafting, propellers and condensers are the product of the Ferguson-Herbert Corporation, an affiliation of the Kearfott interests.

Boilers

Steam is generated in two single ended Scotch boilers 11 feet in diameter and 11 feet long, designed for a working pressure of 150 pounds of steam and built by the Great Lakes Boiler Works, Buffalo, N. Y. Each boiler is provided with two furnaces fitted for coal or oil burning.

Auxiliary Machinery

The auxiliary machinery includes:

One cylindrical condenser with approximately 1,100 square feet of cooling surface.
One 10-inch by 14-inch by 16-inch horizontal simplex air pump.
One centrifugal circulating pump driven by an independent engine.
One 7-inch by 4½-inch by 10-inch feed pump.
One feed water heater with a heating surface of 45 square feet.
One filter tank.
One inspirator of the double tube type.
Two ejectors for discharging bilge water.
One 10-inch by 5-inch by 12-inch bilge pump of the horizontal duplex type.
One 20-inch by 12-inch by 16-inch horizontal duplex fire pump.
One hand bilge pump.
One ventilation blower.

The lighting of the vessel is accomplished by two 10 kilowatt generating sets, located in the engine room, and a small storage battery, provided to supply current for emergency lights.

For steering the vessel there are provided two steam steering engines with cylinders 4½ inches in diameter and 4½-inch stroke. This gear is of the "Hastie" type having twin cylinders mounted above the winding drum. The design has many unique and commendable features, chief of which is the accessibility of the engine.

Design Data

The following enumerates some of the general design data taken from these vessels:

Weights

Hull, steel	305 tons
Hull, wet, paint and cement	135 tons
Fittings, outfit, equipment and stores	37 tons
Machinery	120 tons
Fresh water	18 tons
Fuel oil	33 tons
Margin	30 tons
Total weight of ship without cargo	678 tons

From figures prepared from the lines without allowance for shell plating, rudders, or other appendages, a displacement of 678 tons occurs at a draft of hull of 9 feet. To this should be added, however, one foot additional draft for the skedge.

Table I.—Trim Under Various Fueling Conditions

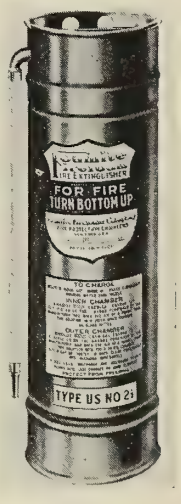
Condition	Displ.	Draft	Trim lever	Mom. to alter trim 1″	Trim
Ship complete, no fuel	645	8′9″	.12′s	82	.95″s
Ship with 33 tons fuel oil	678	9′0″	.30′s	86	2.4″s
Ship with 33 tons coal	678	9′0″	.51′h	86	4″h
Ship with 40 tons coal	685	9′1″	.64′h	87	5″h

Table II.—Trim Under Various Load Conditions

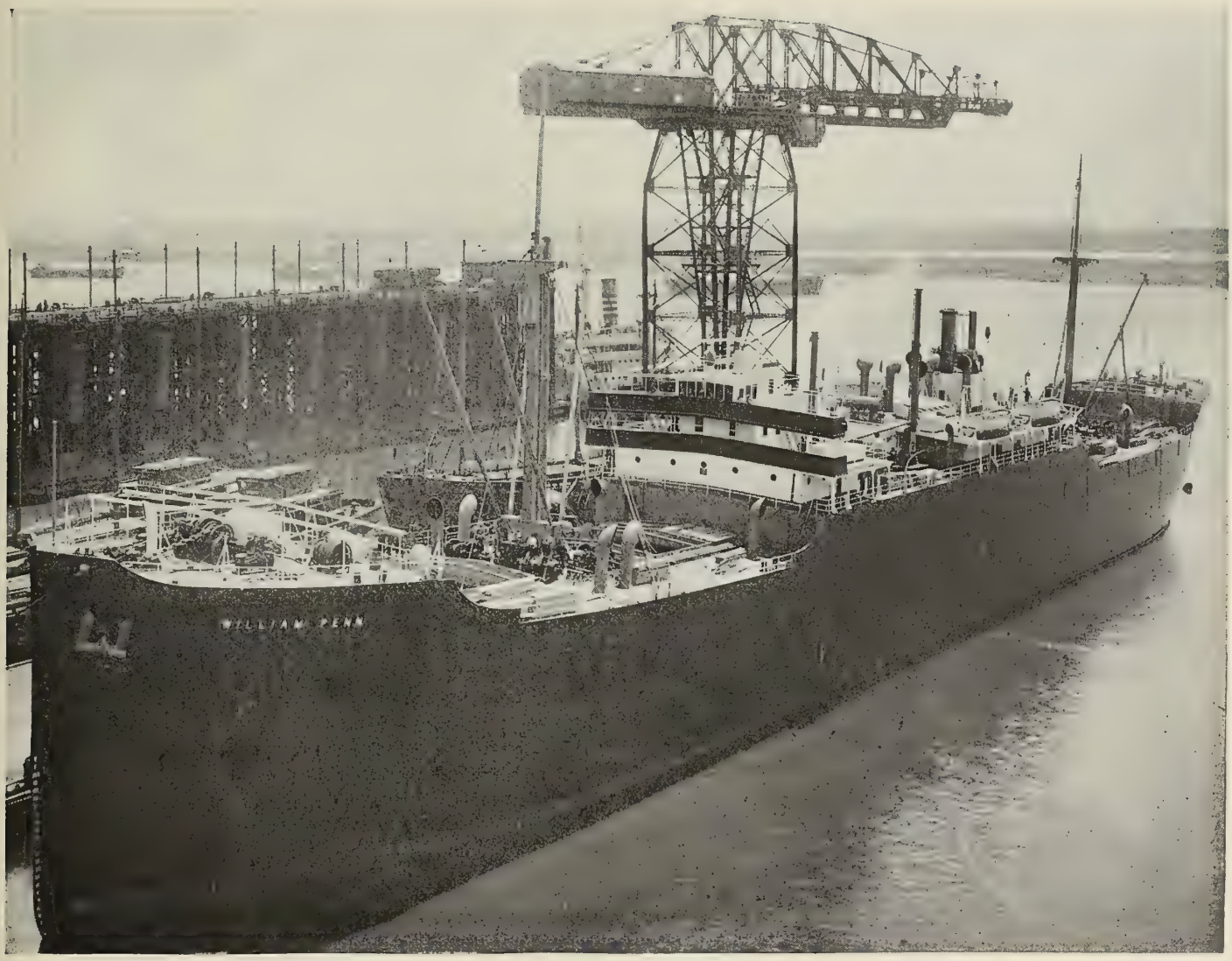
Condition	Displ.	Mean Draft	Trimming Moment	Mom. to Trim 1″	Trim	Change of draft at one end
(1) Ship complete with complement, 18 tons water and 33 tons of oil	678	9′0″	203 S	86	2.4″s	1.2″
(2) As in (1) but with 175 tons of cargo	853	10′4½″	203 S	105	1.9″s	1″
(3) As in (1) but with an 18-ton truck on after end	696	9′2″	1588 S	88	18″s	9″
(4) As in (2) but load (175 tons) located at 29 ft. aft of midships	853	10′4½″	5273 S	105	50″s	25″

Firefoam Hand Fire Extinguisher Approved by Steamboat Inspection Service

THE United States Steamboat Inspection Service has recently approved the U. S. Type No. 2½ Firefoam hand extinguisher manufactured by the Firefoam Company of New York for use on all vessels coming under its jurisdiction. This extinguisher is splash proof which prevents premature mixture of the solutions which might otherwise occur with the rolling of a ship. It is operated by simply inverting and the pressure generated will throw a stream of Firefoam from 30 to 40 feet. About 20 gallons of Firefoam, forming a blanket of carbon dioxide bubbles, are discharged from the extinguisher. The equipment weighs 40 pounds and can be handled by one man. Because of its property of floating on the surface of oil and other inflammable liquids it is claimed that Firefoam is particularly useful for the protection of boiler rooms, engine rooms, fuel oil pumps rooms and other hazardous points.



Hand Fire Extinguisher



William Penn, the Shipping Board's First Motorship

Winch Motors of the Motorship William Penn

Shipping Board's First Motorship Equipped with Electrically Driven Auxiliaries—Winch Motors Rated at 30 Horsepower

By G. A. Pierce*

ONE of the recent developments in marine engineering is the tendency to use electric motors in place of steam engines for driving ship's winches, windlasses, capstans, steering gear, pumps, blowers and other auxiliary machinery. This tendency implies the general recognition of two facts: In the first place, that reliable marine motors are now available; and, secondly, that motors are more satisfactory than steam engines for auxiliary service.

The reliability of motors on shipboard has been amply proved by their records on both naval vessels and motorships. Motor manufacturers have had difficulty in building practical electrical equipment for ships but increasing experience and a better knowledge of marine conditions are providing the remedy for such troubles and it can be proved conclusively that the cases of motor failure have been due to installing apparatus which was not at all suitable for shipboard use.

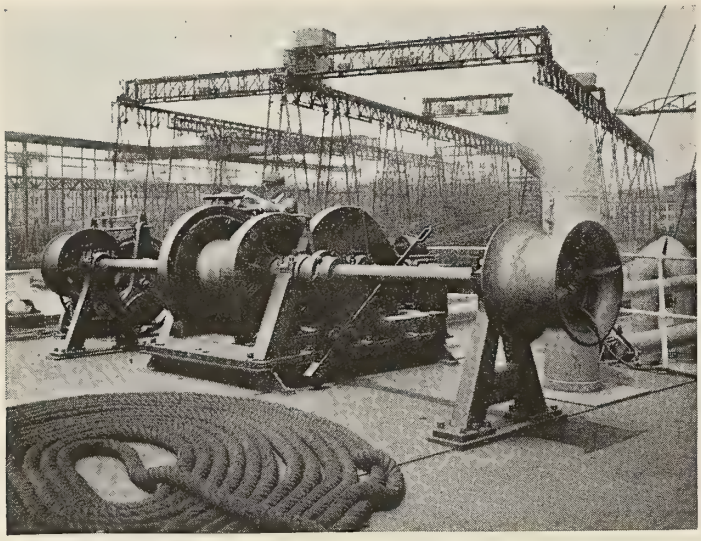
*Electrical Engineer, William Cramp and Sons Ship and Engine Building Company, Philadelphia, Pa.

As regards the desirability of motors from an operating standpoint, such tests as are available indicate that an electric deck auxiliary system requires only from one-third to one-quarter the amount of fuel needed by a corresponding steam system, so that substantial economies can be obtained through the use of motors. In addition, electric wires are far more convenient, economical and satisfactory than steam pipes for distributing power throughout a ship.

The designing of marine auxiliary motors is, however, still in its early stages and no generally accepted standards have as yet been developed. Consequently it is believed that a description of the construction, control and performance of the winch motors of the United States Shipping Board motorship *William Penn,* which are of an entirely new design, will be of interest at this time.

The Motorship William Penn

The *William Penn* is the Shipping Board's first motorship. She is a cargo vessel of 12,358 tons deadweight capacity and



Warping Winch

is propelled by two 2,250 indicated horsepower Burmeister and Wain Diesel engines direct-connected to her propellers. Her hull was built at the Gloucester yards of the Pusey and Jones Corporation and she was fitted out by William Cramp and Sons Ship and Engine Building Company. She is allocated to the Barber Lines, where she is being used in the Far Eastern trade.

Practically all of her auxiliaries are motor-driven, the power being supplied by three 65-kilowatt Diesel engine driven generators, supplying 220-volt direct current. Most of the below-deck motors are of foreign make; but those for the deck winches, anchor windlass and steering gear were supplied by the Westinghouse Electric and Manufacturing Company, in consultation with the William Cramp and Sons Ship and Engine Building Company.

There are eleven deck winches altogether on the *William Penn,* ten being used for cargo handling, with one in the stern for warping. They were built by the American Engineering Company of Philadelphia, in accordance with the Cramp Company's particular requirements. They are of the compound gear type with gear ratios of 12.5 to 1 and of 26.45 to 1, from motor to drum, with the hoisting drum 18 inches in diameter. Each winch has three gypsy heads, two of which are on the first reduction, or counter shaft, and are used for handling light loads and whips. The winches are designed to lift 5,000 pounds on the first gear ratio and 10,000 pounds on the second. A ¾-inch steel hoisting line is used on the drums.

The Winch Motors

In designing the winch motors it was recognized that they must be very different from similar machines for land service and special attention was given to their mechanical strength, waterproofing, ability to withstand high temperatures and their speed characteristics.

Great strength is necessary to withstand the rough handling these motors are bound to receive, so they have been built with cast steel frames and extra large shafts and bearings. The commutators and brushes have also been made especially large in order to eliminate frequent renewals of these wearing parts. The armatures are of specially small diameter to reduce the flywheel (WR^2) effect. This results in an appreciable saving in power when all of the winches are in operation and permits a reduction in the generator capacity.

The frame, which totally encloses all of the working parts of the motor, is split horizontally to permit access to the interior. The joint between the two parts is made waterproof and, for the same purpose, the handhole covers are provided with gaskets. The wires enter through a special watertight junction box and the shafts are made watertight by S. E. A. rings. All small parts usually made of steel, such as springs and bolts, are made of non-corrodible metal. Thus, these motors are capable of withstanding total submergence.

But the arrangements that insure waterproofing also prevent ventilation and, since these motors are liable to be operated when exposed to the full force of the tropical sun, special precautions had to be taken to prevent injury due to high temperatures. Internal heating was, therefore, reduced to a minimum by making all current-carrying parts of liberal proportions, thus cutting down the losses due to resistance, while practically all of the coils are provided with water-and-oil-proof mica or asbestos insulation.

The field windings have been so designed that high speeds are obtained with the empty hook and light loads, and low speeds with heavy loads.

The nominal rating of each of these motors is 30 horsepower at 220 volts.

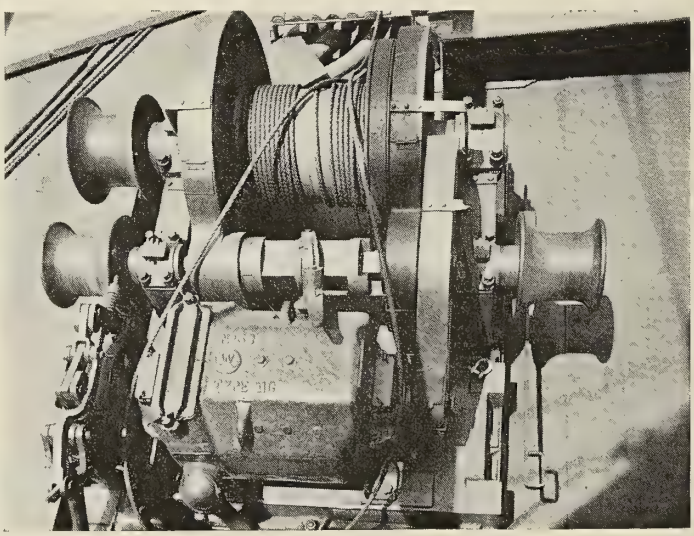
Brakes

Each winch motor is provided with a brake, which is released when the current is turned on and is promptly applied and holds the load when the current is turned off. The brake parts are of non-corrodible metal; the bearing pins of the shoe mechanism are of bronze with brass bushings to prevent sticking. The operating coil is imbedded in a waterproof cement and is enclosed in a watertight housing. Means are provided to release the brake when the current is off in case of necessity.

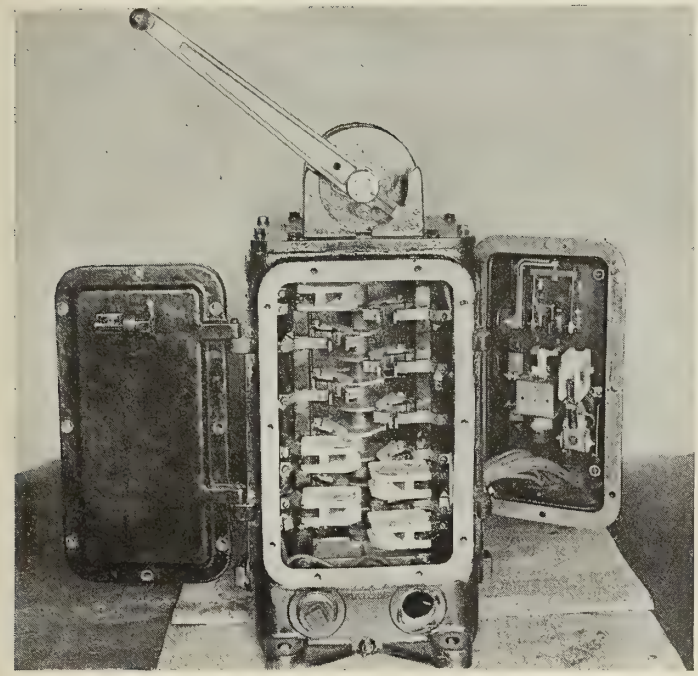
Controllers

The controllers are operated by vertical brass handles, which can be arranged so that one man can operate either one or two winches, as desired. The mechanism is enclosed in a cast iron case, with doors in three sides, giving ready access to the interior. These doors are watertight even when totally submerged. The operating parts are interchangeable as far as possible and can be readily renewed. A small knife switch disconnects the controller from the line so as to permit inspection and repairs without interfering with the operation of the other winches.

The necessary resistors are of non-corroding cast iron and are enclosed in waterproof cases. Ventilation is provided by openings with covers which are raised and lowered by means of a hand wheel. These covers are electrically interlocked with the controllers, so that no motor can be started unless the covers of its resistor are open.



Motor Driven Winch, Showing Method of Mounting the Motor



Winch Controller, with Doors Open

Moving the controller handle in either direction from the vertical position releases the brake, starts the motor in the corresponding direction of rotation and brings it up to full speed in several steps. Moving the handle back towards the vertical position reduces the motor speed; if the load on the hook is sufficiently heavy to lower by its own weight dynamic braking is automatically applied.

Operation

In this process the winch motor is transformed into a generator operated by the weight of the load. Since, under these conditions, the speed of a generator depends upon the current being generated, the speed of the winch motor and therefore of the descending load can be regulated with great nicety by means of the controller. The use of this method greatly increases the speed and safety of handling the cargo; and it also effects some economy as well, since some of the current generated returns to the line and helps to operate the other winches.

When the controller handle is moved to the off position the full force of dynamic braking is applied, thus checking the speed of the load smoothly and almost instantly. The mechanical brake is then automatically applied.

In case of an overload on the motor or the failure of the line voltage, the motor is automatically disconnected from the line by a circuit breaker and the mechanical brake is applied. By bringing the handle of the controller back to the off position the motor is re-connected but if the cause of the trouble has not been removed the circuit breaker immediately opens again.

Other Motors

The anchor windlass motor is similar in design to the winch motors, but is considerably larger, having a capacity of 68 horsepower. Its controller is mounted below decks and is operated by a hand wheel above the deck.

The steering gear motor, which operates the hydraulic pump of the steering gear continuously, has non-corrodible parts, impregnated windings and bearings that will operate at an angle.

Performance and Tests

Tests on the winch motors gave the following results:

Rope speed, no-load, hoist.....457 feet per minute
Rope speed, no-load, lower.....337 feet per minute
Rope speed, 5000-pound load, hoist.....170 feet per minute
Rope speed, 5000-pound load, lower.....470 feet per minute
(The above figures are for operation on high gear)

The maximum continuous cargo handling capacity of each winch motor was found to be 45 tons an hour. That is to say, the motors could handle cargo at this rate indefinitely without injury if the loads could be supplied to them. When operating with two winches lifting 4,000-pound loads 80 tons per hour can be handled by each pair of winches and the ship could be loaded at this rate in 30 hours of continuous operation. However, it was found that the speed of loading was dependent upon the dock facilities, as the winches were able to handle cargo more rapidly than it could be supplied to them.

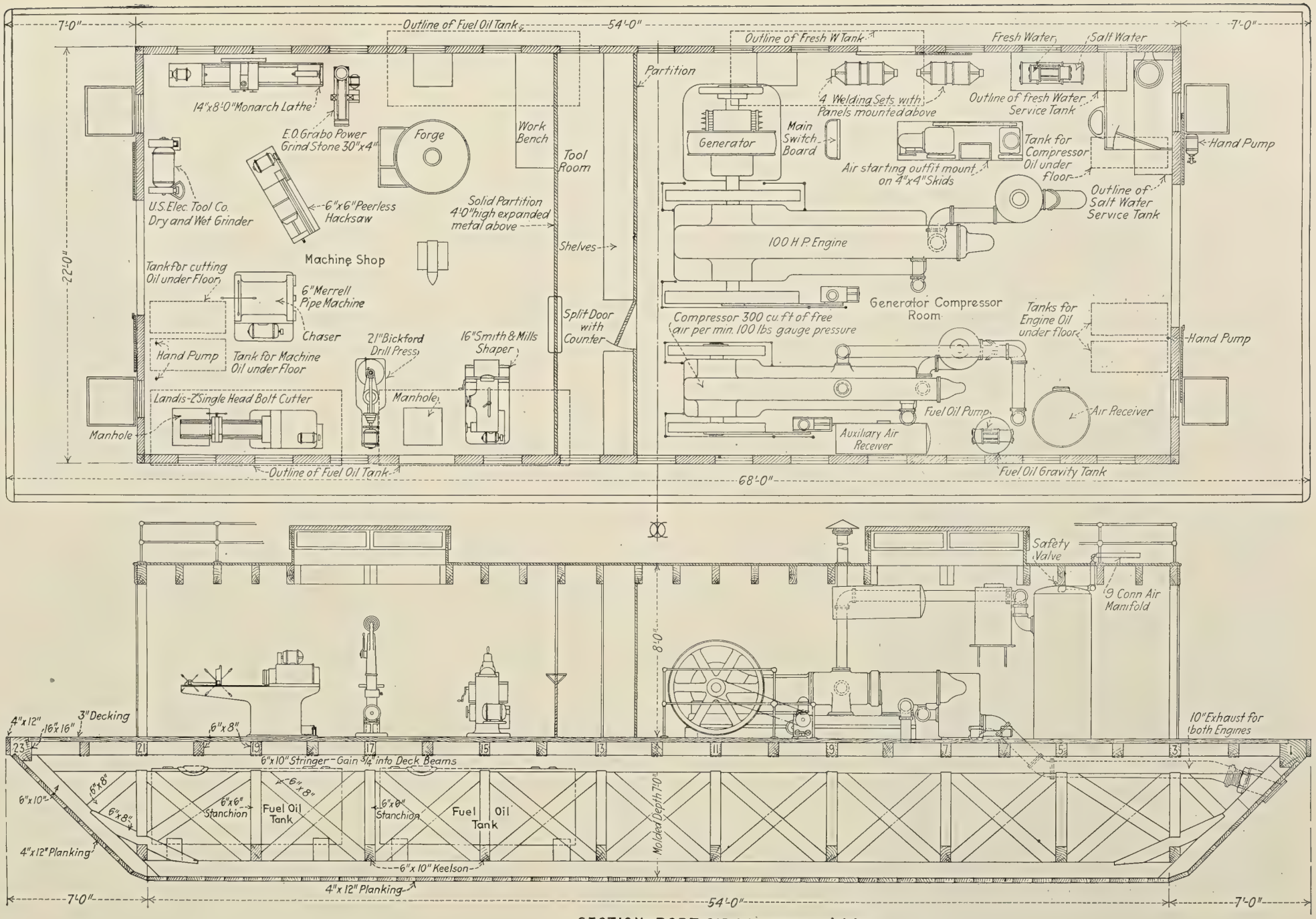
The fuel consumption of the auxiliary Diesel engines, when supplying current for electric lighting, all auxiliaries and all ten winch motors, was 90 gallons of oil per 24-hour day, the winches being in use for 8 hours.

Industrial Crawling Tractor Crane

TWO new types of "Industrial" crawling tractor cranes developed to meet the need for full revolving tractors which can be operated independently of rails are being built by the Industrial Works, Bay City, Mich. One type having a capacity of 20,000 pounds at a boom radius of 12 feet is equipped with continuous crawling tractor belts while the second crane with a capacity of 18,000 pounds at a 10-foot radius is equipped with four broad-gage tractor wheels. Either crane is arranged to handle a hook and block, a grab bucket, an electric lifting magnet, a shovel dipper or a drop hammer in conjunction with pile driver leads, whichever is required by the service in which the crane is to be used.

A special feature of the equipment is the internal combustion engine which supplies power both for hoisting and propelling purposes. The crane is equipped with a 30-foot boom made up of two channels and latticed angles and tie plates. By means of friction clutches and brakes controlling the motion of each tractor belt or of each set of tractor wheels the operator is able accurately to control the steering of the crane while it is in motion. This is accomplished by disconnecting one tractor belt from the motor while the other belt continues traveling at the normal rate of speed. The disconnected tractor belt can be held stationary by applying the brake or can be allowed to coast with the brake and clutch both disengaged, or, if the clutch is allowed to slip, the operator can cause the crane to turn as sharp, or as wide, a corner as he may desire. The entire mechanism both for hoisting and for propelling is contained in the revolving cab on the upper works.

"Industrial" Crane With Crawling Tractor Belts



SECTION PORT SIDE LOOKING S'T'B'D

General Arrangement of Machinery in the Federal Repair Barge

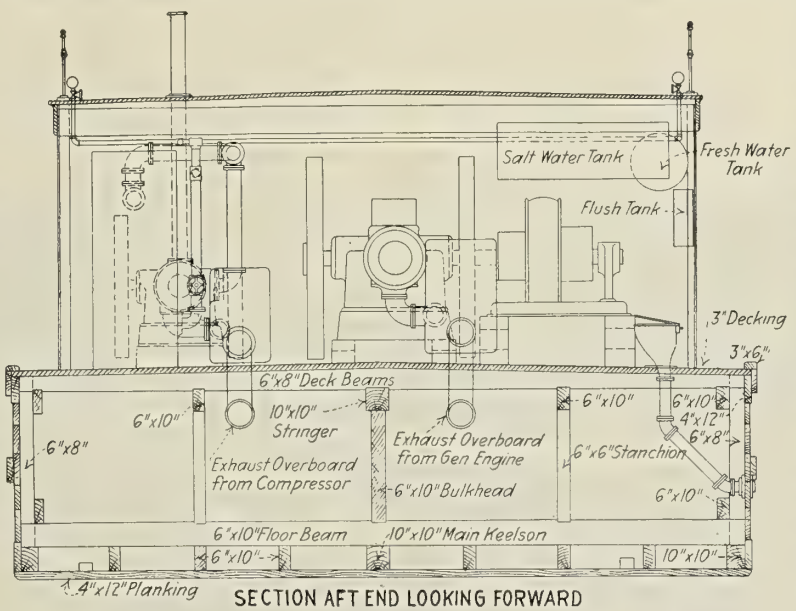
Nine Thousand Ton Dry Dock and Welding Repair Barge in the Wet Dock of the Federal Yard

Federal Shipyard Takes Up Ship Repairing

Nine Thousand Ton Floating Dry Dock and Combined Welding Barge and Machine Shop Added to Yard Equipment

FOR the combined purpose of maintaining the ships of the subsidiary operating companies of the United States Steel Corporation, and also to engage in a general ship repair business, the Federal Shipbuilding Company, Kearny, N. J., has within the past few months built up a complete repair organization and recently increased the facilities of the yard by the addition of a 9,000-ton floating dry dock and a floating welding barge and machine shop.

The Federal yard, which was completed in 1918, is one of the largest shipbuilding plants on the Atlantic coast, having building ways for twelve 15,000-ton vessels. The yard occupies a site comprising 170 acres with a water frontage on the Hackensack river of 2,400 feet. The layout of shops and ways in relation to each other, the material handling equipment and shop equipment have been designed with the one idea of promoting productive efficiency. At the down-river end of the shipways is a wet basin for fitting out and in which the new dry dock is located. Serving the wet dock is a 100-ton, 3-leg jib crane which is of great importance both in fitting out new ships and in repair work for handling boilers, propellers and other heavy materials.

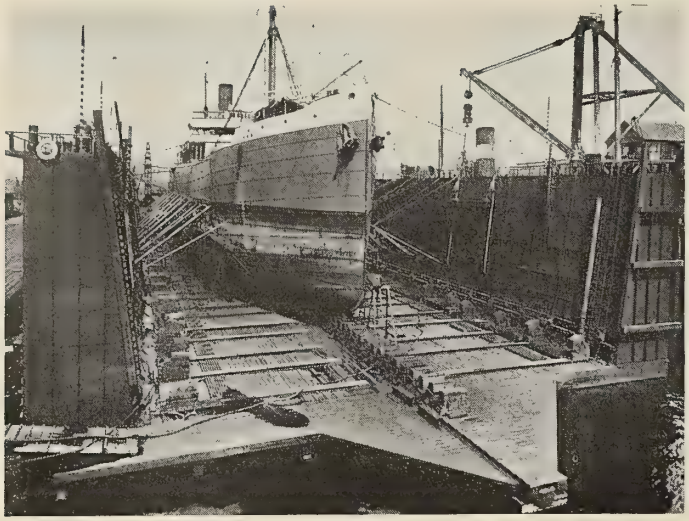


Section Through the Compressor and Generating Room of the Repair Barge

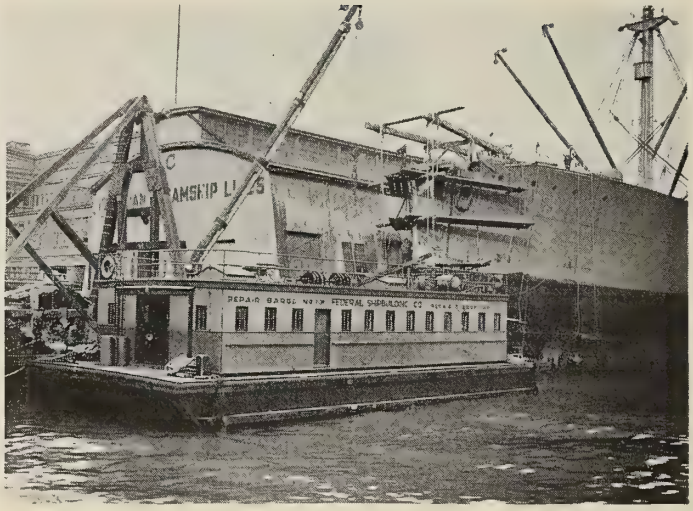
Details of Dry Dock

The new dry dock, which is of the rigid, steel wing-wall type, built according to the William T. Donnelly patent rights, was put into commission June 23 when the steamship *Suhulco* of the Transmarine Corporation was docked for repairs. The overall length of the dock on the keel blocks is 440 feet and its overall width 110 feet. Vessels having a draft of 22 feet can be docked and ships up to 9,000 tons deadweight and 475 feet in length can be raised. Nine wooden pontoons built of Oregon fir each 110 feet long, 41 feet wide and 13 feet deep were used in the construction of the dock. The steel wing-walls which run continuously across the pontoons are used to equalize any irregularity of pumping or pontoon buoyancy and to absorb stresses which in the case of certain other types of floating dry docks are liable to be transmitted to the ship. The steel wing-walls used on this dock are the longest continuous walls of any in the New York district.

The pumping equipment consists of eighteen 12-inch centrifugal pumps operated by individual 30-horsepower General Electric motors. A pump is located at the outer end of each pontoon directly under the wing-walls and its shaft is extended to the motor located on the wing-wall deck Motors can be controlled individually or in groups from the controller house located on the wharf and one man in the controller house is able to regulate the entire pumping equipment of the dock. The sinking of the dock is governed by gate valves at the end of each pontoon; the wheels of these valves are located on the top of the wing-walls near the motors. Water is admitted through these gates for submerging the dock and the same gates are used for discharging while the dock is being raised. A ship can be raised in the dock at the rate of nearly a foot a minute.



Steamship Bantu Being Reconditioned in Dry Dock



Repair Barge at Work on the Bow of a Steamship

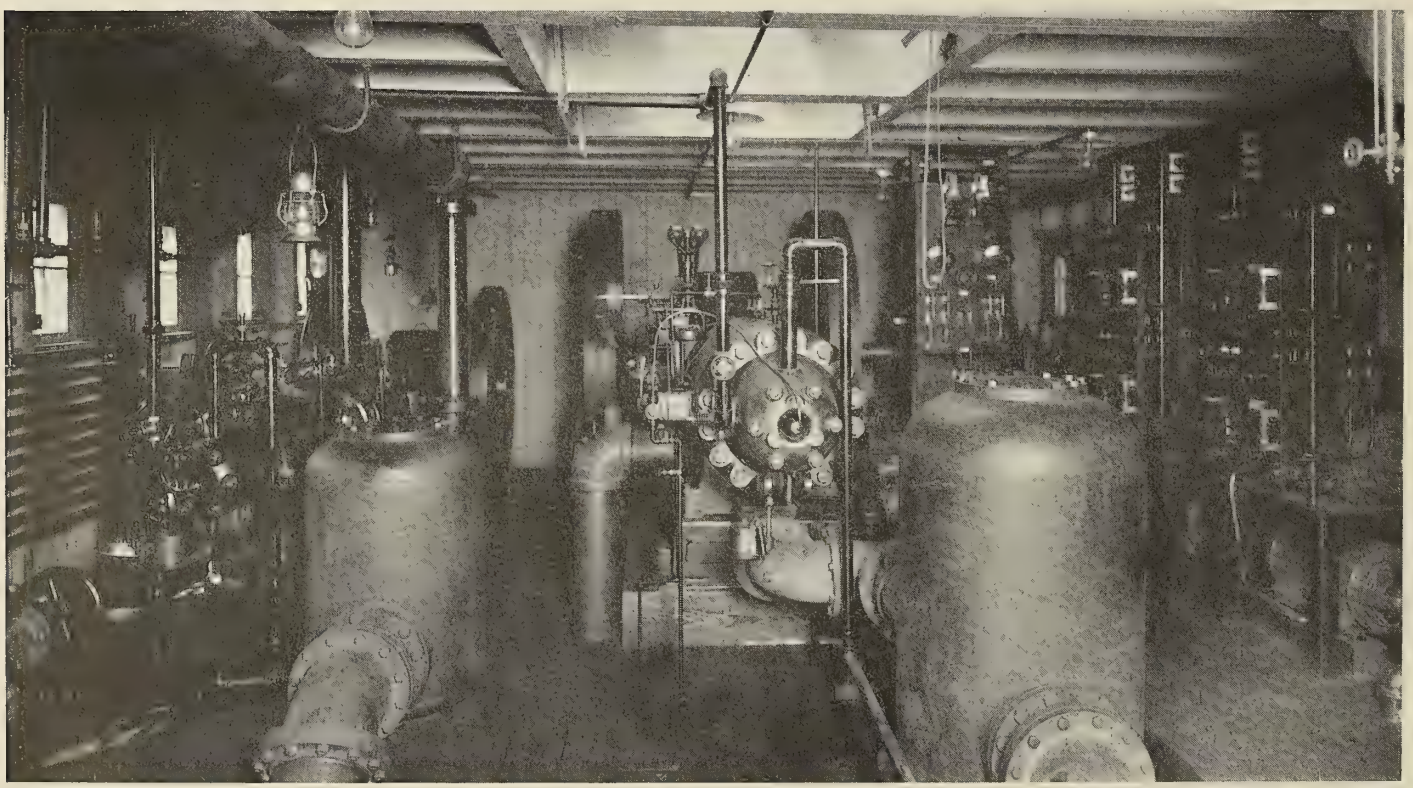
Air and fresh water lines run the length of the dock and it is adequately supplied with facilities for temporary lighting from the power lines of the yard. A feature of this dock is the system of permanent scaffolding provided, which consists of hinged galvanized pipe booms from which painters' platforms are hung by blocks and falls. These booms are lowered against the side of a ship when it is docked and provide quick access for work on all parts of a ship's side plating. A feature of this scaffold system is the possibility of using short handle brushes in painting a vessel, which eliminates the use of long handles and permits the men more efficiently to cover a surface. In cleaning and scraping the plating these scaffolds are useful in allowing the men to get close to the work. When not in use the booms and the scaffolds are hauled back against the wing-walls where they are clear of all other rigging.

Access to the dock is by means of two gangpanks at the west end and one gangplank at the east end. A stairway connects the top of the south wing-wall to the wharf and a light bridge set in place by a locomotive crane connects the ship's deck to the wing-wall. By means of this stairway and bridge material can be carried to and from the ship without the use of ladders. Ships on which stern repairs are to be made are docked stern first and propellers, heavy staging and the like are handled by a 35-ton locomotive crane operating from the wharf.

Construction Record for Dry Dock

Actual construction on the dock started January, 1921, when the framing of the first pontoon was begun, the last pontoon being launched in May. The dock was ready for operation by June 18, the first boat being docked as noted on June 25. Since beginning operation the dock has been constantly in service.

In order to carry on minor repairs the Federal Company recently put into commission a floating power plant and



Interior of the Compressor Room of the Barge, Showing the "Little Giant," 100 Horsepower Semi-Diesel Engine, the Compressing Unit, the Main Switchboard and Welding Equipment

machine shop for handling work both at the yard and on vessels taking on or discharging a cargo at any point in New York harbor. A special feature of the new barge is the power generating and air compressing machinery, consisting of a 100 horsepower semi-Diesel horizontal oil engine driving an 80-kilowatt direct current generator and a similar type semi-Diesel engine direct connected to a 300 cubic foot horizontal air compressor. The barge is of wooden construction and has the following dimensions:

Length over all	68 feet
Beam	26 feet
Length on bottom	54 feet
Rake at ends	7 feet
Depth molded	7 feet
Load draft	2 feet 9 inches
Camber of deck	2½ inches

The deckhouse has a length of 54 feet and a width over the planking of 22 feet. The clear height at the centerline is 8 feet and two 8-foot by 5-foot skylights are provided. Two transverse partitions amidships form a tool room, on one side of which is located the generator and compressor room and on the other the machine shop. Between the frames and the bracing in the hold of the barge are located three 1,000 gallon capacity fuel oil tanks, one 1,000 gallon capacity fresh water tank, one 60-gallon capacity lubricating oil tank for compressors, two 60-gallon capacity engine lubricating oil tanks, one 60-gallon capacity machine lubricating oil tank and one 60-gallon capacity cutting oil tank.

Generator and Compressing Machinery

The power plant as noted consists of one 100-horsepower, single cylinder semi-Diesel engine driving an 80-kilowatt, 125-volt direct current generator; a semi-Diesel oil engine direct connected to a horizontal air compressor for operating air tools and one small gas engine driven compressor used for supplying starting air to the engines. Power for operating four, 3-kilowatt motor generator welding sets, machine tools and lights is furnished through a main switchboard by the generator.

The semi-Diesel oil engine, supplied by the Chicago Pneumatic Tool Company, is of the horizontal straight line crosshead type mounted on a sub-base designed to reduce the vibration which in a barge of this size would be excessive without special provisions as in this case. This type engine is valveless utilizing the two-stroke cycle with low compression. All parts in the crank case are readily accessible for maintenance and repair. Ignition is secured by the injection of fuel into a hot liner in the combustion chamber.

The air compressor unit, also manufactured by the Chicago Pneumatic Tool Company, has a capacity of 300 cubic feet per minute at 100 pounds gage discharge pressure. Briefly, this machine is of the horizontal direct connected type with the power cylinder and air cylinder in tandem on a common piston rod separated by a tandem piece which affords access to the stuffing boxes for both cylinders. The power cylinder is similar in action to the oil engine described above while the air cylinder is of the double acting type fitted with flat disk inlet and discharge valves.

The fuel oil is pumped from the storage tanks into gravity tanks located over the engines by a 3-inch by 2¾-inch by 4-inch horizontal duplex piston pump. The fresh water service is handled by a 3-inch by 2¾-inch by 4-inch horizontal duplex pump which also supplies the lavatory and fresh injection water to the oil engine cylinders. A 5½-inch by 3½-inch by 5-inch horizontal duplex pump serves the purpose of a bilge, fire and general service pump. This pump has suctions from the bilges and from the sea. It discharges overboard and to the fire and sanitary systems. All pumps are air driven. A complete hot water heating plant, consisting of pipe radiators and a small boiler of the American Radiator Company type, is installed.

The electric welding outfit consists of four 3-kilowatt General Electric one-man welding machines. The generators for these units are direct current compound wound machines operating at 125/160 volts and 150 amperes. Motors for these sets run at 1,700 revolutions per minute. Each set is supplied with a welding control panel and with sufficient wiring to permit operation of the electrodes in any part of the ship on which repairs are being carried out. Current control for lighting and power distribution from the generator is maintained through a main switchboard installed near the power unit. Oxy-acetylene welding and cutting torches and gas tanks are carried as part of the equipment for use when work by this process is found necessary. A full equipment of electric and air hand tools is provided.

Equipment of Machine Shop

The machine shop section of the barge is completely fitted out for practically all light engine repair operations. The equipment in the shop includes a 14-inch by 8-inch Monarch geared engine lathe, a United States Electric Tool Company wet and dry grinder, a 6-inch by 6-inch Peerless hack saw, a 6-inch Merrell pipe machine, 2-inch Landis single head bolt cutter, a 21-inch Bickford drill press, a 16-inch Smith & Mills geared crank shaper, a 30-inch by 4-inch wet grinder, a 12-inch double emery grinder, a 45-inch forge with canopy hood and motor driven blower.

Current Work of the Repair Unit

During the month of September dry dock and repair work has been done on the *Bantu, Steel Inventor, Steel Ranger, Steel Age,* and *Robin Goodfellow.* One of these ships, the *Steel Age,* is now being completed and work is in progress on the *Grand Republic.* Within a short time reconditioning of the *Charlton Hall, Bessemer City* and *Steel Voyager* will be commenced.

Portable Belt Conveyor Used at Tampa for Coaling Ships

BY using a portable belt conveyor the Tampa Coaling Company, Tampa, Fla., has achieved mechanical coaling of ships at low first cost of machinery, low upkeep cost and considerable capacity. With the conveyor shown in the illustration, which is manufactured by the Barber-Greene

Coaling Ship with Portable Belt Conveyor

Company, Aurora, Ill., vessels are coaled at the rate of 400 tons a day. Usually the coal is taken from the storage pile shown on the dock but if railroad cars of coal arrive at the dock at the same time the ships are to be coaled, the process is simplified. A second conveyor takes the coal from the car, discharges it directly onto the inclined conveyor and the coal is put aboard the vessel at a minimum expense in time and labor.

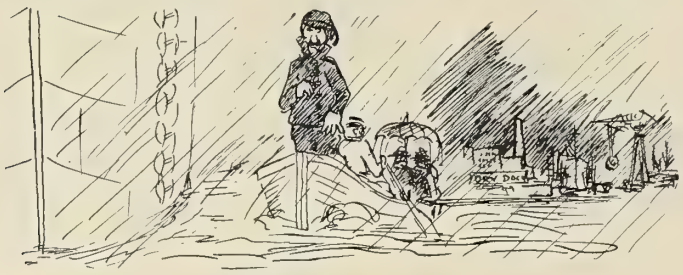
The Most Interesting Job in the Yard

Under the above title a letter was published in our last issue telling why a machinist in the engineering department of a large ship repair yard considered his job the most interesting one in the yard. This was a challenge we invited our readers to accept and this month a member of the "white collar crew" in the engineer's office vividly explains why his job has a claim to this title. What do YOU *think about it? If your job is entitled to consideration in this controversy (and it probably is), here is a chance to explain its interesting features which other men in the yard probably know little or nothing about. Who's next?*

I HAVE read various articles written under the above heading, but I have never read one dealing with the Engineering Department, that miscalled "white collar crew," of which I have the honor to be a member, although I must confess that the only time I wear a white collar is to and from my work.

Granted that the shop work is interesting, also grant that all of the other branches in the yard are interesting to those engaged in them, but how about this "white collar pencil pushin' guy?"

Suppose some cold, rainy, windy day when all the elements seem to have set out to do their darnedest, a ship comes limping into port with bottom trouble. Word goes to the "Old Man" and he in turn sends for one of the engineers. The following conversation takes place:



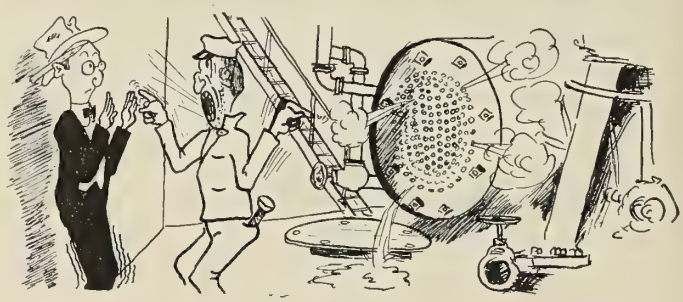
Tug, Launch or Raft

"Brown," says the "Old Man," as the door opens, "There's a ship down the river by the name of *Blank*. We want to dock her. Haven't any docking plans. Go down and look her over and get back here as soon as possible. Want to take her on the next tide."

Brown says, "Yes, sir," and beats it. It is now his job to get aboard the ship *Blank* on a tug, launch or raft, it is all the same to the "Old Man." So he puts on his oil-skins and lights his pipe, if he be of the tobacco burning kind, and sallies forth. After many trials and tribulations he finds himself aboard the good ship *Blank*, where his troubles ought to be at an end. But not so, the crew of this good ship speaks no English, so Brown has to go about his work the best he can.

However, in due time Brown returns to the yard where he turns his stuff over to the "Old Man" and gets the third degree until he, who thought he had every measurement just right, begins to think that he is all wrong. But he sticks to his story and the dope is passed out to the yard where the dock is laid out to his specifications.

Finally the vessel arrives and goes into dock and proves that Brown's measurements are about right after all. Brown himself in the meantime has been like a turkey on a hot griddle until he had seen the dock pumped dry and the ship safe on her blocks.

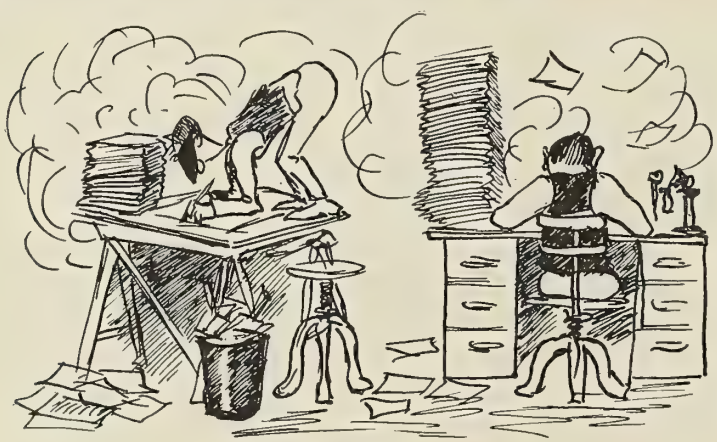


Condenser Trouble

That is one phase of an engineer's job. Now let us take another.

Suppose a vessel has condenser trouble. Brown goes on the job. The ship's engineer doesn't know how many tubes are leaking or anything else about it, except that it is out of whack and he wants it fixed. The vessel has just arrived in port and has all kind of trouble getting in, the crew hasn't had time to open anything up. Nevertheless the owners want a price for fixing things up in a first-class condition and it is up to Brown to collect enough data to make that price.

In this instance Brown has to be a cross between a prophet and a Houdini. After listening to the chief engineer express



As They Are

As the Yard Thinks

his opinion of the proposed cut in the engineer's pay and of the fellow who sold him the last lot of fuel and various other subjects he finally runs into the mate.

The mate is apt to tell him about the kind of food his wife has been feeding the baby in his absence and ask Brown's opinion of it. Brown, being a good fellow, talks long and learnedly on the various baby foods, although the subject is rather far fetched from leaky condensers.

Along about this time the captain comes along and, being away from the port for a long time, wants to know all the latest news and winds up by giving Brown a couple of wicked looking cigars, which upon trial cannot be smoked.

Now as this has taken up quite a bit of Brown's time he drops below to have a look at the condenser that is causing the trouble. Then by taking what he sees and dividing it by two and extracting the square root, or some other such method known only to engineers (for I am not permitted to divulge any secrets of the klan), he goes back to the yard with his answer.

That all sounds easy. But wait, the bid goes in for the work and the firm's competitor gets the job!

The "Old Man," through some unknown source, has learned that upon actual examination there were only three

The Gang at the Keyhole

tubes leaking, a fact which the worthy competitor knew, but Brown, who had thought and said fifteen, did not.

The answer is this: The chief engineer had given Brown an earful of gas, the mate had told him all of his woes, the captain had given him a couple of cigars and his own "Old Man" gives him h—l.

And that is another interesting phase of the business. There is yet another, probably the most interesting of all, especially to those directly concerned.

A man, or group of men, buys a ship. The ship in an old ship that has given up going to sea years ago and is peacefully living out its days on some mud bank. This group of men conceives the notion that there is a fortune to be made by fixing up the old ship and running her out to Kalamazoo or some other sea port and comes to the yard, asking for a price on the work necessary to make her all new and shiny again.

The price with all the necessary dope must be ready by a certain day and hour, so Brown and the rest of the gang hop to it. Drawings are made, weights are figured both correct and incorrect. Everybody hustles, even the boy is made to realize the importance of the thing. So it goes day and night until the fatal hour arrives and with it the "big wigs" who started all the trouble.

The "Old Man," in his best business manner, goes over every detail with the utmost care. The "big wigs" are very much interested until the very end and then, after thanking the "Old Man" for his courtesy and interest in their behalf, gently inform him that they do not intend to have the work done, but had only wondered what it would have cost.

It is then that the gang, who have been listening at the keyhole, take to the tall timber until the storm blows itself out.

The above are three of the reasons why I say the most interesting job in the yard is in the engineer's office. For to be an engineer one must know his own business and a bit of everyone's. He must be courteous to his competitors and willing to take a gambling chance. He must be so optimistic and thick skinned that he is immune from knocks and, above all, he must be able to shed his troubles like water from a duck's back. However, it is a good old business even if an angry engineer with poetical tendencies did remark the following:

Oh an engineer's life is a jolly life,
As jolly as jolly can be.
Damned if you do, damned if you don't,
That's what happens to me.

Philadelphia, Pa. John J. Strutt.

Wage Subsidy Proposed for the Merchant Marine

(*Concluded from page* 804)

The conclusion of American shipowners is that the leverage of the high level of the American wage standard can be exerted only in the case of vessels with a terminus at a United States port, whereas a vessel that operates from a European terminal, as do most of those under foreign flags, will inevitably derive an advantage from a difference in wage standards. This, say the operators, is proving to be the case even with British vessels that run on a triangular route, one leg of the voyage reaching Great Britain. Logically it might follow that, if the effect of the seaman's law in the United States has been to increase the wages of seamen, firemen, etc., and thereby force up the pay of officers, in order that the proper relationship be maintained, the same indirect pressure would be communicated to the British marine. But the United States shipowners insist that even if the higher American standard has automatically pulled up the wage of British enlisted seamen, etc., this same leverage cannot be applied in the case of British officers for at least four or five years to come or until such time as the surplus of officers now available in England has been absorbed.

While disclaiming any desire or intention to interfere with the American wage scale, United States ship operators who have voiced in Washington the sentiments of the shipping industry have emphasized the fact that it would be greatly to the advantage of the American merchant marine if wage inequalities could be relieved by such a plan as the Butler Bill contemplates instead of relying upon the development of superior efficiency on the part of American operatives to overcome the handicap.

Electrical Equipment for Erie Canal Motor Barges

THE General Electric Company, Schenectady, N. Y., has recently supplied the electric auxiliary equipment for five Diesel engined barges, built by the McDougall Duluth Shipbuilding Company, Duluth, Minn., for the Erie Canal Transportation Company of New York.

The barges are 250 feet long, 36 feet beam and 10 feet draft, each being equipped with a 140 brake horsepower direct reversible Skandia Pacific Diesel engine. The displacement of each barge is 2,150 tons, the block coefficient 0.86 and the midship section coefficient 0.9833.

The electric equipment consists of three 10 kilowatt 400 revolutions per minute generators each driven by a 15 horsepower Diesel engine for auxiliary power and lighting on each barge. There are also seven electric motors ranging from 1 to 10 horsepower to be used on pumps, steering gear, windlasses, etc.

Timbers and Lumber for Shipbuilding Purposes—III

By Horace Holden Thayer*

Continuation of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the classes of workers who have to deal with these materials from the materials point of view.

POINTS of particular interest which have come under the writer's observation in connection with the use of the woods previously mentioned will now be considered under the heading of the construction member concerned.

Decking

Edge Grain should always be specified for a Douglas Fir calked deck, and it is preferable for a Yellow Pine deck.

Decking of the same dimensions both ways allows the selection of the upper face from any of the four faces, thus largely taking care of the edge grain requirements.

To avoid damages in transit decking should be surfaced at the shipyard.

The tendency is to outgage too much for calking. For decking 4 inches or 5 inches thick an outgage of 3/32 inch tapering off to nothing to a depth of 2½ inches, which will make a seam that is theoretically 3/16 inch wide at the face, is plenty; or for thinner planks an outgage of 1/16 inch tapering off to nothing half way through the plank is a good rule.

There is considerable difference of opinion regarding the relative merits of calked wood decking or tongue and groove canvas covered decking for the exposed tops of houses and other superstructure of a vessel. Both have their merits and such considerations as tropical service, traffic on the deck, location of the deck with regard to the stack, etc., have to be taken into account. For fair comparison and also as a standard of good practice the calked decking should not be less than 2¼ inches thick when finished and the joiner decking not less than 1⅜ inches.

Floors and Frames

In a wood ship the lowest framing members are called floors, the timbers butting against them, first futtocks, and so on up to the deck where the last futtock of each frame member is usually called the top timber. Where the bottom of the vessel has a considerable deadrise and the lowest frame members butt close to the keel, they are often called naval timbers.

The conventional steel ship midship section which is best for ease of propulsion, with small deadrise and small bilge radius adds to timber schedule difficulties. It makes floor timbers of the lengths desired by the classification societies and bilge futtock timbers of the necessary width and length difficult to obtain. This does not trouble the West Coast builders as much as others.

A vessel framed with White Oak is under a weight handicap as compared with one framed with Yellow Pine and both are under a handicap as compared with one framed with Douglas Fir unless the scantlings of the heavier woods can be proportionally reduced.

As previously mentioned salting may be required with White Oak framing where it would not be required with Yellow Pine or Douglas Fir. This with a large vessel means a reduction in the deadweight of a good many tons.

The possibility of bad results from mixed framing, or the use of two species of wood, in building up the frames has been referred to.

Where natural crooks cannot be obtained for the bilge futtocks the classification society may call for compensation in the shape of additional timbers or the edge bolting of the bilge planking. Natural crooks should as far as possible be used for all frame futtocks of sharp curvature.

A shipbuilder can get the most out of such timbers as frame futtocks by ordering flitches, which are merely slabs sawed to the desired thickness for the siding of fore and aft dimension of the frame and with the bark left on the other two faces. Except where furnished to templet the width specified to be furnished should be present at the narrowest point inside of the bark. The width for invoicing is usually the average of both faces at the midlength. The value of templets has been previously mentioned.

The reduction in the molded size of frame timbers at the butts, allowed by the classification societies, can also be taken advantage of in getting out difficult curved timbers.

Preparation of a frame molding plan in which the framing timbers are laid out as they will appear in the finished vessel is often of value. Sections are taken at proper distances apart to allow the timbers ordered from any section to take care of all frames up to those taken care of by the adjacent sections. In ordering timbers in this manner an allowance for the bevel of the frames must not be overlooked.

Green timbers should always be used for the steamed and bent oak frames of small vessels. The steam drives out the sap and when the frames dry they will hold their shape for years. If seasoned oak is used it will soon lose its shape at least sufficiently to destroy the attractive appearance of the sheer line of the vessel.

Joinerwork

All boards should be kiln dried.

When ordering tongued and grooved material it is important to specify the finish that will meet the requirements of the particular case in accordance with the standards of the mills, as for instance D. & M. for sheathing of which only one side is exposed and S2S CM for decking.

Knees

Knees should be natural crooks in order that they will not split, and only those woods are suitable which are tough and have good holding power for fastenings. Root knees are the best and where a tree grows on a slope the uphill side supplies the closed bevel knees and the downhill side the open bevel knees.

Steel knees can be obtained or made up and are entirely satisfactory in locations where not covered with timbers which would interfere with their proper fastening.

Beam knees can in many cases be advantageously supplanted by additional strength in the shelves and clamps.

Masts and Booms

During the recent war the following procedure was adopted with classification society approval covering the changes in diameter wherever measured of masts and booms which had

*Member of Rossell & Thayer, naval architects and marine engineers, Philadelphia, Pa.

been specified to be of Douglas Fir and for which the other woods listed might be desired, all being graded similarly for knots and other defects.

	Percent Increase	Percent Decrease
Dense Southern Y. P.	..	10
Southern Y. P., not dense	0	0
Norway Pine	5	..
Spruce	30	..

Planking

Lengths should be to satisfy classification requirements and any deficiency in this regard can only be compensated for, if at all, by extra fastenings. The ordering of the planking and ceiling of large vessels in specified lengths rather than in the customary way of 30 feet and up, average 36 feet, etc., will help in securing a proper shift of butts; but such procedure is generally unnecessary and inadvisable.

The wider the planking, the less the labor, fastenings and calking. Bottom planking can usually be made quite wide.

Planking is preferably ordered S1S2E, surface one side and two edges; and where there is any sap, the surfaced side should be the sap side, and the heart side should be placed against the frames, notwithstanding the fact that sapwood is objectionable in calking edges. The reason for this has been explained under "Length of Life" of the timbers.

Some of the planking of upperworks should be ordered in greater widths than shown on the midship section plan on account of the sheer and flare.

The remarks under Decking regarding outgaging apply also to Planking. Outgaging is preferably done at the shipyard.

For wood tugboats and other wood vessels subject to rough service and a good deal of knocking about, White Oak planking is very desirable and will keep down maintenance charges.

Planksheers

The working out of difficult curved pieces of planksheers, rails and similar parts of the work from timbers of limited width can be helped by the use of anchor stocks instead of the regulation scarf. The anchor stock is a piece of timber which fits into both connecting members exactly as one half of a scarf on one member fits into the other member.

Rudder

Ironbark and Greenheart are good rudder stock woods, selected northern White Oak can generally be relied upon, but the southern White Oak has little torsional strength and when severely stressed reaches a condition where it can be twisted around without turning the rudder.

A steel stock on a wood rudder is a good combination on a wood ship back of a wood rudderpost. The complete steel rudder is costly, very heavy for the overhang to support, and unless built to suit the width of the rudder post has considerable ineffective surface.

Shaft Log

White Oak is a good wood for this on account of its high holding power for fastenings notwithstanding its tendency to check.

Sills

Oak is not a good material for outside sills and similar service where watertightness is desired of parts that are usually kept very dry. This is on account of the before mentioned tendency to check badly.

Stem

The outer stem of a wood vessel is preferably of hardwood, such as White Oak and the stem gripe at the bottom, or piece between the stem and the keel should be of hardwood. For the latter all species of oak, hard maple, beech, birch and other hardwoods that will last well under water may be used.

The stem gripe may often be done away with by extending the stem timber downward, and while the longer timber may be more difficult to obtain the gripe piece will often prove still more so.

Stern Post

The stern post of a single screw wood steamship has to be cut from a timber or timbers much larger than the finished post, on account of the shaft boss. This results in exposing the wood near the center of the stick that with oak often has bad heart shakes and other defects which are likely to cause the condemnation of the timber after a great deal of work has been put upon it.

Although White Oak is otherwise the proper wood to use in the east, Yellow Pine of increased fore and aft dimensions can be substituted for it, whether a single timber or built up.

On the west coast, propeller posts of the largest size likely to be required can be made from one piece of medium growth clear butt Douglas Fir.

Treenails

Woods for treenails have to be strong, tough, hard, straight grained, non-porous and of approximately the same volume whether wet or dry. The approved woods are Yellow or Black Locust, Iron Bark, Osage Orange or Bois d'Arc, and Live Oak. The Live Oak has the undesirable property of sometimes shrinking to an oval shape when seasoning, thus requiring re-turning. White Oak is occasionally approved for service below the light waterline and should give satisfaction in such service when properly driven. Beech treenails may be approved in the bottom planking to a height not higher than the heads of the floors.

Treenails used for pinning the two members of a double frame together, to assist in holding the parts in place while the framing is being erected and before the ceiling and planking fastenings accomplish this purpose, may be of the same material as the frames, subject to classification approval.

The average shrinkage in crossection, or the volume shrinkage, from a green to an oven-dry condition of the principal woods used or proposed for treenails, as determined by the Forest Service, is as below given. The shrinkages from a green to an air dry condition are about one-half of these amounts. The figures are in percent of the dimensions when green.

Osage Orange	8.9
Black Locust	9.8
Live Oak	14.7
White Oak	14.3 to 16.9
Beech	15.8 to 16.5
Hickory	15.0 to 21.2
California Eucalyptus	22.5

Hickory and California Eucalyptus are more permeable to water than the other woods in addition to their being subject to greater change in volume, and as before mentioned are not good treenail woods.

White Oak treenails should be kept in a vat of hot creosote for at least 24 hours before being driven.

As of interest for comparison and from the fact that the woods are used for pinning frame members together, we find the following corresponding shrinkages:

Long Leaf Yellow Pine	11.0 to 12.8
Douglas Fir (Washington and Oregon)	12.3 to 13.2

As previously stated shrinkage of wood along the grain is negligible, and the shrinkage of treenails or other members across the annual rings is only about one-half of the shrinkage along these rings. Therefore, for best results, when driving treenails the annual rings of the treenail should be turned perpendicular to the grain of the planking and ceiling through which they are driven.

Treenails are preferably tapered, the point being 1/16 inch less in diameter than the head when up to 30 inches long and 1/8 inch less when 30 inches long and over. They should

be driven into a hole one-half of which is bored about 1/16 inch less in diameter than the head of the treenail and the other half enough smaller to be a good tight fit for the point of the treenail. Treenails of this character of hexagon shape are on the market and meet with classification approval. If the tapered treenails cannot be readily obtained or made, the treenails may be turned in two drifts, one half being 1/16 inch less in diameter than the other half; and the hole is made in two drifts to correspond. This enables long treenails to be driven without brooming and splitting. Short treenails can be satisfactorily driven by a competent workman when of uniform diameter throughout. All treenails should have a bevel at the point.

Where the shipbuilder is equipped to re-turn the treenails it is preferable to order them rough turned to 1/16 inch over the normal diameter. This will take care of any irregular shrinkage and also allow the builder to accommodate the finished diameters to the wear of the augers used for boring the treenail holes.

Treenails should be ordered at least 4 inches longer than the combined thickness of the material through which they are to be driven. This allows something to come and go on in the driving fit and also allows of sawing off ends which may have been damaged in driving.

The following specifications prepared by the Forest Service for use of the Emergency Fleet Corporation are of value in ordering treenails.

Treenail Squares

All squares to be entirely free of spike knots and knots in clusters, and to be sound except for the following defects which will be allowed. Sound material excludes squares containing worm holes which cannot be removed in turning, any form of rot or decay, powder post, and incased bark.

1. Sound knots, the aggregate diameter of which does not exceed ½ inch in each and every 12 inches of length, provided no knot is larger than ¼ inch in average diameter and no ¼ inch knot is closer than 2 inches to any other knot.
2. Cross or spiral grain not exceeding in slope more than 1 inch in a length of 20 inches.
3. Season checks, splits and shakes extending into the treenail for a distance not exceeding 1 inch on each end.
4. Sap on one end not exceeding ¼ inch in thickness on any face or ⅜ inch on any corner for a distance of not more than ¼ the length of the piece.

(Sap, in addition to that allowed in item 4, wane surface, worm holes, or similar defects which, in the judgment of the inspector, can be removed in turning the treenail will also be allowed. Iron streaks will not be considered defects.)

Size

Squares to be cut to sizes specified, allowing 1/16 inch variation in thickness and width and ½ inch in length.

Finish

All squares to be rough sawn.

Turned Treenails

To be thoroughly seasoned (approximately 15 percent moisture). All treenails to be entirely free of spike knots, knots in clusters and to be sound. All treenails to be entirely of heartwood, except as allowed below. The following defects will be allowed. Sound material excludes treenails containing worm holes, any form of rot or decay, powder post, and incased bark.

1. Sound knots, the aggregate diameter of which does not exceed ½ inch in each and every 12 inches of length, provided no knot is larger than ¼ inch in average diameter and no ¼ inch knot is closer than 2 inches to any other knot.
2. Cross or spiral grain with a slope not exceeding 1 inch in a length of 20 inches.
3. Season checks, splits and shakes extending into the treenail for a distance not exceeding 1 inch on each end.
4. Sap not exceeding ⅛ inch in thickness nor more than ¼ the length of the treenail on the pointed end only.

(Iron streaks will not be considered a defect. Dips in the grain, which at the maximum slope do not exceed the allowable cross grain will be permitted.)

The foregoing specifications do not obviate the necessity for inspection of the material. Also sound pieces of approved species of wood that would pass them might be light in weight and very far below the normal strength of the species.

Treenails are wedged at the ends in order to produce the same result as the head on a driven bolt and where possible the treenails should be driven all the way through and wedged on both ends. The wedge should be set across the grain of the wood through which the treenail is driven so as to have no tendency to split this wood. The necessity for wedging the ends of treenails is one of the reasons why treenails have to be of a harder wood than that through which they are driven. Where treenails are of the same wood as the planks, they are so much lower in compression across the grain than the plank is in compression along the grain that the wedging crushes the treenail instead of expanding it into the plank.

In many cases where treenails cannot be driven through and wedged on both ends it is desirable to "fox" them; that is, a wedge is fitted in the inner end of the treenail and driven home against the bottom of the hole by driving the treenail home.

Wedges should be of a hard, long lived and close grained wood. White oak is very desirable although dense yellow pine heart wood has been used to a considerable extent with classification approval.

A good rule for treenail diameters is:

Thickness of Outside Planking	Diameter of Treenails
2 inches and under	⅞ inch
2½ inches	1 inch
3 inches and 3½ inches	1⅛ inches
4 inches and 4½ inches	1¼ inches
5 inches and 5½ inches	1⅜ inches
6 inches and over	1½ inches

Order of Shipment of Hull Material

If the timbers ordered for a wood ship are required for prompt use it is even more necessary to specify the order in which they should be received than for a steel ship; because otherwise the mills will ship first what they can most readily get out, and this is invariably the light stuff that is not needed until the last. A good general guide is as follows, the staging material, keel blocks, ribbands and shores being assumed to be on hand.

First Shipment

Mold material
Keel and keel shoe
Stem and stem gripe
Stern frame
Floors and frames
Chocks
Cross spalls
Knightheads and apron
Deadwoods
End framing
Keelsons and machinery foundation timbers
Horn timbers
Shaft log
Rudder blade and stock

Second Shipment

Bottom, bilge and side ceiling
Clamps and shelves
Hold beams
Deck beams
Knees
Deck girders and hatch coamings
Stanchions
Hatch strongbacks
Deck waterways
Riders, pointers and breast hooks
Garboard planking
Bottom, bilge and side planking
Poop, bridge and f'c'stle shelf, clamps and plankshee

Poop, bridge and f'c'stle ceiling
Poop, bridge and f'c'stle beams
Bulkheads
Coal bunkers
Shaft tunnel
Wood bitts
Calked decking
Poop, bridge and f'c'stle and bulwark planking
Main rail
Fenders
Bilge keel
Deck machinery foundations

Third Shipment

Sills and plates
House studding
House carlins
Tongued and grooved decking
House sheathing, outside and inside
Partitions
Hatch covers
Secondary rails

The Amount of Wood in a Wood Vessel

On account of the nature of the material dealt with, the great number of different methods of putting it together in a wood vessel, and the differences due to the use of different species of wood, it is difficult to determine in advance without a detailed calculation the amount of timber that will be required for any new design; and even with a detailed calculation there are many items that are difficult to correctly estimate. Approximations can, however, be made along the lines of those for the amount of steel in a steel vessel which were given in an earlier paper.

The schedule of timbers and lumber required for the yellow pine Standard Wood Steamship of the Emergency Fleet Corporation as originally designed totaled about 1,420,000 board feet. This does not include the knees and treenails or any material not a part of the vessel itself. The length at the deck level from the forward side of the stem to the after side of the rudder post is 268 feet, the breadth is 45 feet 2 inches and the depth molded is 26 feet. The product of these dimensions multiplied by the coefficient 4.5 gives the board feet.

The corresponding schedule of the sister ship built of Douglas Fir totaled about 1,670,000 board feet, giving a coefficient of 5.3. This 17¾ percent increase over the Yellow Pine ship is somewhat more than it should be because the framing of the latter was reduced in size more than was warranted by the relative strengths of the woods, in order to arrive at sizes that could more readily be obtained in large quantities.

A somewhat larger Yellow Pine steamship which has a steel center keelson shows on the same basis a coefficient of about 4.0 and a Douglas Fir steamship of about the size of this latter with a wood center keelson but a steel sheerstrake, waist and deck stringer plate has a coefficient of about 4.5.

Other designs of about the size of the Standard Wood Steamship, built of Douglas Fir, have coefficients from 4.8 to 5.5, on the same basis.

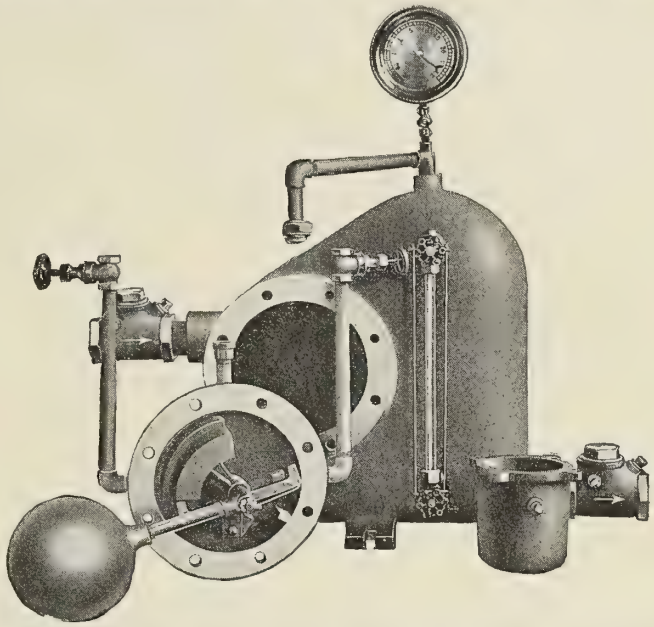
The schedule of timbers and lumber required for the Standard Wood Schooner Barge of the Emergency Fleet Corporation totalled about 710,000 board feet. The dimensions corresponding to those of the Standard Wood Steamship before given, are 229 feet 5 inches by 37 feet 0 inches by 20 feet 6 inches. The product of these dimensions multiplied by the coefficient 4.1 gives the board feet of timbers and lumber. These barges were classed and designed to be built of either Yellow Pine or Douglas Fir; so this amount might properly be considered to be the requirement for the latter.

Barges similar to the above built in New England before the war of Yellow Pine, with a considerable amount of hardwood framing, had timber schedule requirements of only 560,000 board feet. Corresponding dimensions were 229 feet 5 inches by 37 feet 9 inches by 21 feet 0 inches, with corresponding coefficient of 3.1.

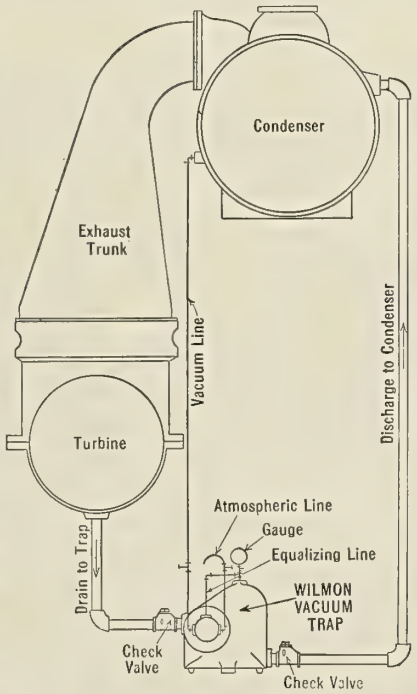
The foregoing figures while of value in enabling one to arrive at a rough approximation of the actual requirements, show clearly the great variations even with vessels of the same size and type.

Vacuum Trap Used for Turbine Drainage

WHILE Commander Vaughn V. Woodward, U. S. N., was chief engineer of the steamship *Leviathan* during the war he perfected and installed what was then a new type vacuum trap for draining the two low pressure turbines and replacing the customary main air pump drainage of these turbines. Recently this apparatus has been produced commercially by P. H. Gill and Sons Forge and Machine Works, Brooklyn, N. Y., under the name "Wilmon Vacuum Trap." In its development the vacuum trap has been found satisfactory for lifting and when equipped with a counting device to perform the functions of a meter. The trap has also been found suitable for draining apparatus under vacuum such as condensers, evaporators, cooking kettles and the like.



Wilmon Vacuum Trap, with Cover and Float Mechanism Removed



Method of Draining Steam Turbine Through Vacuum Trap Into a Condenser Located Above the Turbine

In marine installations where the common practice is to deliver the condensate at a higher point of discharge and to drain the turbines directly into the main air pump the use of the vacuum trap eliminates the use of the main air

pump by leading the turbine drains through the trap to the condenser.

While the water is collecting in the trap the receiving chamber is under vacuum, and during the discharge cycle the trap is open to the atmosphere. These changes of pressure are brought about in the receiving chamber by an oscillating disk covering three ports, which shifts from one position to another with the rise of the water in the trap acting on a hammer weighted float mechanism connected to the disk lever. When the water reaches a certain level in the trap the disk closes the vacuum line to the receiver and opens it to the atmospheric and equalizing line. If the outlet is connected to a vacuum as in the case of a condenser the water is forced out of the trap; otherwise it drains into the atmosphere by gravity. As the water falls the oscillating disk cuts off the atmospheric line and connects the vacuum and equalizing lines, allowing the water to collect again from the turbines.

The capacity of the trap is limited only by the size of the inlet and outlet openings. The 2-inch trap, for example, handles 1,800 to 2,100 gallons of water per hour. This capacity varies depending on the lift of the discharge.

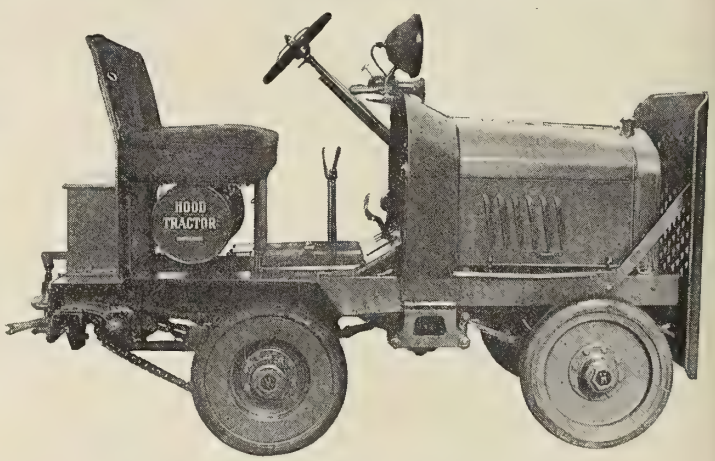
Combination Ore and Oil Steamer G. Harrison Smith Delivered to International Petroleum Company

THE *G. Harrison Smith,* a 20,000-ton combination ore and oil vessel built at the Sparrow's Point plant of the Bethlehem Shipbuilding Corporation, Ltd., for the International Petroleum Company, was delivered to her owners on September 12, after a very successful trial, which was run on August 30 at Sparrow's Point, Md.

The vessel has a length overall of 571 feet 6 inches, a breadth of 72 feet and a depth of 44 feet. She is equipped with three single ended Scotch boilers and triple expansion reciprocating engines with cylinders 25, 41 and 68 inches diameter and 48 inches stroke. The boilers are equipped with the Bethlehem-Dahl mechanical oil burning system fitted with Howden type of forced draft.

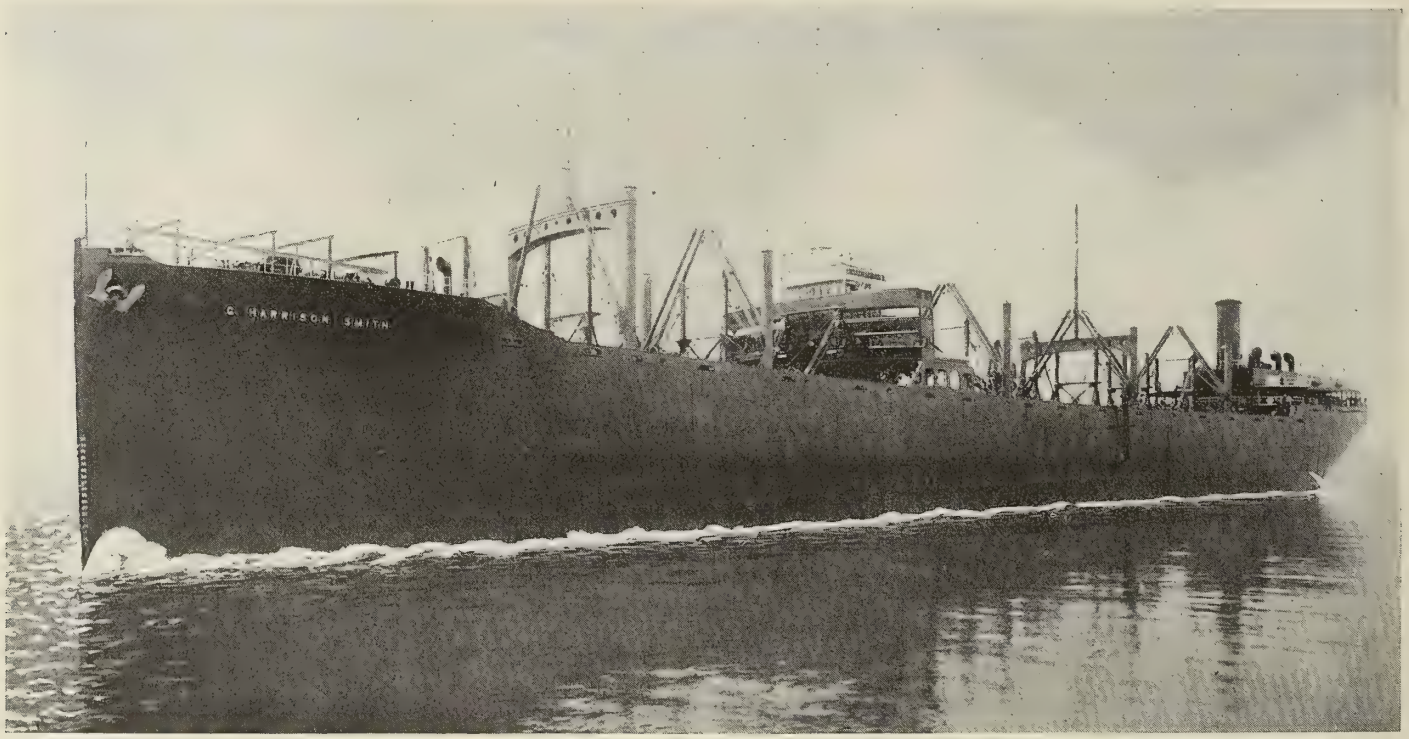
Tractor Speeds Up Freight Movements in Pier Transit Sheds and Warehouses

AT the October convention of Port Authorities in Seattle, Wash., a new model tractor, manufactured by the Hood Tractor Company, of Seattle, was demonstrated. This machine has been specially designed for dock and warehouse handling of freight on trailer trains as well as the shunting of freight cars on pier sidings. A special steering gear allows the tractor and ten trailers in a train to turn on a platform or aisle 12 feet wide. The manufacturers claim that all ten trailers can be turned at right angles from one aisle 6 feet wide to another 6 feet wide. The bumper is so designed that wherever the bumper passes the balance of the machine will pass.



Hood Tractor for Marine Terminal Service

The tractor is also used for spotting and switching cars on the docks. The motor is 22½ horsepower; the tread of the tractor is 36 inches and the wheel base 43 inches. As the motor is running nearly all the time while the tractor is in service an over size radiator is provided and a specially designed water pump which prevents overheating. The weight of the entire machine is 2,900 pounds.



20,000-Ton Combination Ore and Oil Steamer G. Harrison Smith

The New Sulzer Diesel Engine

By A. P. Chalkley

Among the very large number of different types of Diesel engine, which are now being installed in ships in Europe, the Sulzer design has attracted a vast amount of interest. In the latest Sulzer engine a considerable advance appears to have been made. The first two sets of the new design have just been completed at the Winterthur Works and are now being installed in a 9,000-ton deadweight motorship which will probably go on trial before the end of the year.

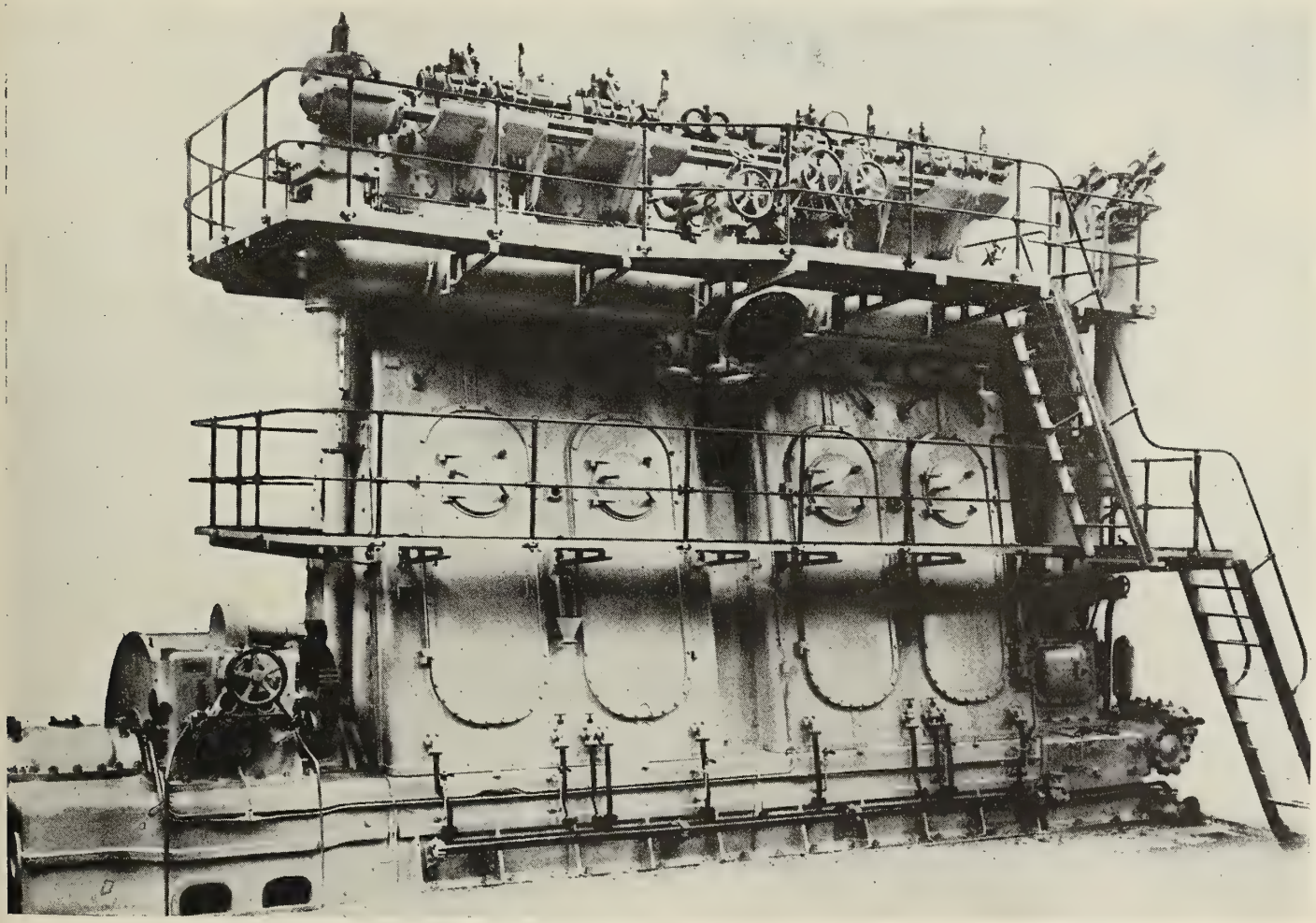
THE advantages of the employment of the two cycle principle in large marine oil engines cannot be ignored, particularly when, as in the new Sulzer motor just brought out, all possibilities of cylinder cover cracks developing owing to the heat stresses are eliminated.

This engine, of which illustrations are given as built for a 9,000-ton motorship, has an output of 1,350 brake horsepower at 95 revolutions per minute and it is worthy of note that the builders are now willing to manufacture similar motors up to 6,000 brake horsepower in six cylinders, under the usual guarantee. The cylinder dimensions are 630 millimeters bore and 1,060 millimeters stroke and the weight is in the neighborhood of 150 tons which is considerably lower than that of a corresponding four cycle motor.

Before describing the general features of construction, the scavenging system, which has now been introduced for the first time, may be mentioned. In the ordinary way with a two stroke Diesel engine, scavenging air is supplied at the requisite pressure of about 2 to 3 pounds per square inch from a large pump driven from a crank on an extension of the main engine shaft. This pump running at say 100 revolutions per minute (or whatever the speed of the engine may be) is naturally of bulky construction, is heavy and has the disadvantage of adding a further crank to the engine unless it be driven by means of beam levers from a crosshead which has other disadvantages. Moreover the scavenging air is not under control and, until the engine has started up, no scavenging air is available for the working cylinders, while the pressure cannot be raised if desired.

Separate Turbo Scavenging Blower Provided

The designers have in this new type entirely abandoned the engine driven scavenging pump, which incidentally absorbs about 10 percent of the power, and the scavenging air is supplied from a separate turbo scavenging blower running at about 2,000 revolutions per minute. The electric motor is of 150 brake horsepower and in normal circumstances one set supplies sufficient air for operating two engines in a twin screw vessel while a second blower is pro-

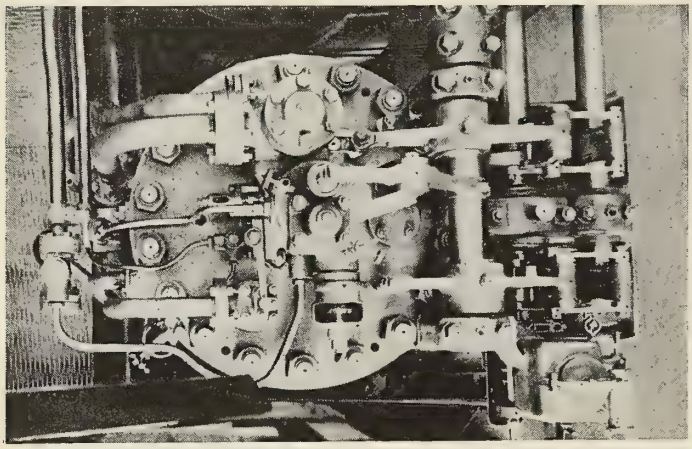


The New 1,350 Brake Horsepower Sulzer Marine Diesel Engine with Turbo-Scavenging

vided as a stand-by. The result is that the engine is shortened and rendered lighter, while 8 to 10 percent is added to the power delivered by the propeller shaft. As regards cost there is probably little difference between the turbo system and the adoption of an engine driven pump, but the makers consider the advantages sufficiently numerous to have standardized the arrangement in all their engines of about 1,000 brake horsepower and over.

Cylinders Supported by Cast Iron Framing

Turning now to the general features of the design it is a curious fact that while the Sulzers were the first to adopt the construction by which the cylinder stresses are taken by long through bolts extending from the bottom of the bearings to the top of the cylinders, and were followed in this design by most other Diesel engine builders, they have now abandoned it and the cylinders are supported solely from the cast iron framing. At the level of the bottom of the cylinders, as seen in the illustration, is a long scavenging trunk into which the scavenging air is delivered from the turbo blower. In the cylinder walls are cut the exhaust



Cylinder Cover of Sulzer Engine, Showing Valve Operating Mechanism

ports on one side and the scavenging ports on the other but above the main scavenging ports is a second set communicating with the scavenging trunk through rotary valves enclosed within the latter and operated from the vertical shaft which drives the camshaft. The object of this upper set is to allow a supercharge of scavenging air to enter the cylinders after the exhaust ports and the main scavenging ports have been closed by the piston in the course of its upward stroke.

Cylinder Cover Design

The cylinder cover is of interesting and unusual design. There is only one hole bored in the cover into which is fitted a cage arranged for the reception of the fuel valve, the starting valve and the relief valve. This is perhaps one of the neatest features of the Sulzer engine for it renders possible a very symmetrical cylinder cover design which would scarcely be feasible in any other way. The starting valve within the cage is not actuated from a cam on the camshaft in the ordinary way but is opened at starting by a cam on a maneuvering spindle and actuated by the starting mechanism. There is a secondary air inlet valve which controls the admission of starting air to the cylinders via the main valves and which is itself operated from the camshaft by cam and lever in the ordinary manner. One of the main objects of this arrangement is to prevent the starting valve sticking, for it can be taken out at any time on the voyage and cleaned since it is not in communication with the cylinder while the engne is operating on oil.

Valve Operating Mechanism

The valve operating mechanism in this engine is greatly simplified by the employment of port scavenging. The fuel valves and auxiliary starting valves are actuated by levers from a camshaft in the ordinary manner and there are two cams side by side for ahead and astern running respectively. Instead of moving the camshaft fore and aft, which is the customary method with most four cycle Diesel engines, there are two rollers on the end of each valve lever, either of which can be brought in contact with its cam, one for ahead and one for astern operation. When the ahead cam is in contact with its roller, the astern cam is out of contact with the astern roller and vice versa, the movement being controlled by the reversing wheel at the control platform. In reversing, the reversing wheel is turned bringing the astern cams into operation and the starting lever is moved, causing the main starting valves to be opened and admitting compressed air to all four cylinders. Without the attendant carrying out any further operation two cylinders are next automatically cut off from air and put on to fuel and finally all four cylinders on fuel, the main starting valves being then closed and the auxiliary starting valve levers out of contact with their cams.

A new point in the design which has not been adopted with other engines is a means by which the lift of the fuel valve can be increased or decreased according to the speed and power of the engine. It will be noticed that the engine controls are arranged at the top of the engine but this is not essential and they can be grouped at the bottom in the ordinary manner, if desired. All the starting gear is of course interlocked so that the starting lever cannot be moved until the cams and levers are set for running either in the ahead or astern position.

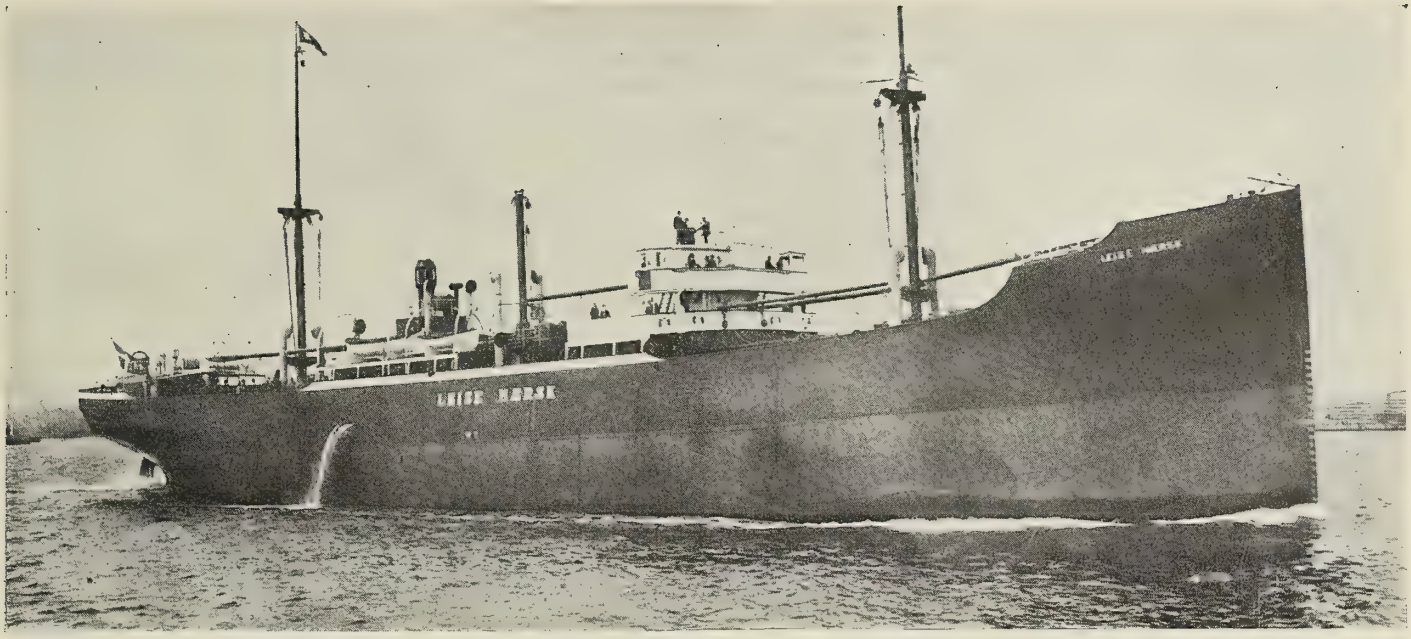
Pumps and Compressor Driven from Main Engine

Most Diesel engines are arranged so that the various auxiliary pumps are separately driven, either by electric motors or steam engines. The new Sulzer engine is more self-contained and the lubricating oil pumps as well as the circulating pumps for piston and cylinder cooling water and, of course, the three stage air compressor are all operated from the engine itself.

A novelty has been introduced by the employment of a separate lubricating pump for lubricating the crosshead, oil being supplied at high pressure (200 to 250 pounds per square inch) to all the main crossheads. The remainder of the lubrication is virtually by gravity for the oil is pumped from a sump up to a tank well above the engine which feeds the various points to be lubricated.

Fresh water is utilized both for pistons and cylinder cooling, although it is now not unusual to adopt fresh water cooling for the pistons and in the Burmeister and Wain latest design fresh water is used throughout. Obviously the sea water system is more convenient, since it avoids the necessity for fresh water coolers in the engine room. The cooling water is delivered to the pistons through a telescopic pipe on one side of the rod and is discharged through a similar pipe on the opposite side. As none of the moving joints is under pressure leakage is improbable.

One of the major advantages of this engine is stated to be its capacity for using crude oil such as is burned under boilers. The reason given is that as there are no exhaust or scavenging valves in the cylinder cover there is no possibility of their becoming corroded as in a four cycle motor and that apart from the fact that there must necessarily be somewhat more wear on the liner owing to the larger asphalt content in the fuel, there will be no difference in operation, whether the engines be run on Diesel oil of low specific gravity, or fuel oil. This claim is far reaching and, if it can be justified in practice, it will be a considerable asset since Diesel oil is nearly 50 percent dearer than fuel oil.



Leise Mærsk, the First Large Motorship to Be Fitted with Burmeister and Wain Long Stroke Engine

Motorship Building in Europe

By Our Special London Correspondent

Something of a sensation was caused in European shipping and shipbuilding circles a short time ago when the first large geared Diesel liner sailed on its maiden voyage. From an engineering standpoint the machinery installation is one of the most remarkable that has yet been carried out on any vessel afloat. This article briefly explains how high speed submarine engines have been successfully adapted to the propulsion of a 12-knot cargo vessel.

It has already been remarked in these columns that the utmost secrecy is being observed regarding motorship construction in Germany and few people were even aware that two 12,000-ton motorships were being built for the Hamburg-American Line in which geared Diesel engines are installed. The vessel which has just been completed is the *Havelland,* built by Blohm and Voss, Hamburg. A sister ship, the *Munsterland,* was launched in August and presumably will be placed in commission before the end of the year.

The *Havelland* has the following principal dimensions:

Length over all	465 feet
Length between perpendiculars	450 feet
Breadth	58 feet
Side height to main deck	29 feet 6½ inches
Carrying capacity	10,235 tons
Draft	25 feet 1 5/16 inches
Gross registered tonnage	6,308 tons
Net registered tonnage	3,829 tons
Oil capacity (fuel)	1,400 tons
Speed	12 knots
Shaft horsepower	3,300

The ship is of the well deck type with long poop and forecastle; she has two continuous steel decks and is built to the highest class of Germanic Lloyds. There are eight watertight bulkheads extending to the main deck. Accommodations are provided for twelve passengers.

The Main Engines

The two main engines are of the four stroke cycle type and were built for submarines during the war by the Augsburg works of the firm Augsburg-Nürnberg. The firm of Blohm and Voss is licensed by this firm to build these engines and has already built several, two of which have been in use in its power plant for several years.

Each engine has ten cylinders, 20⅞ inches diameter, with a stroke of 20⅞ inches. The number of revolutions, which was to be 390 for submarine propulsion, was reduced to 230, which gives a piston speed of 13.3 feet per second. The mean indicated pressure has similarly been reduced from 117.8 to 102.2 pounds per square inch. With these factors each engine develops 1,650 shaft horsepower.

The reduction gears have a ratio of 2.7:1 so that the propeller makes 85 revolutions per minute. The important question of the perfect operation of reduction gears between engine and propeller was examined on a test stand, using gears of the actual size. In this connection, it became necessary to offset the negative turning moments, which occur with oil engines and are especially great in the neighborhood of the critical speed, in order to prevent excessive wear of the gear teeth. This end has been attained in the installation in question, not by the addition of separate, often unreliable, elements, but by proper proportioning of the transmission shafting and a suitable distribution of revolving masses or balance weights.

During the trial trip, by means of special apparatus, the twisting moments in the shaft, ahead and abaft the reduction gears, were measured photographically; this measurement revealed a uniformity of twisting moment in the shaft on a par with that of a turbine installation.

Savings in Weight and Space

The present installation, in comparison with a direct oil engine drive, made possible a saving in weight of 330 tons

and in space of 6,000 cubic feet. By suitable proportioning the engine room to the size of the installation, which for certain reasons was not possible in this ship, an additional saving of 18,000 cubic feet could be made.

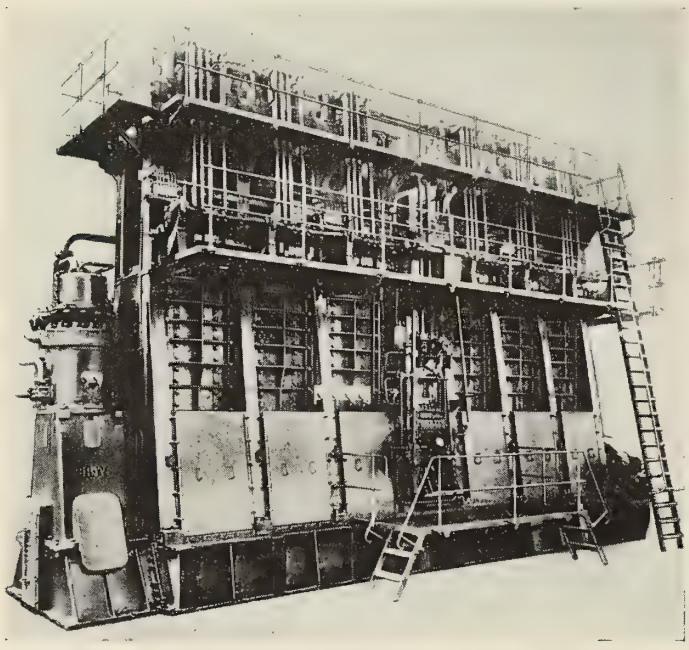
All auxiliary machinery, including the steering engine and the thirteen cargo winches, is electrically driven.

The ship made her trial trip on August 30, 1921. The reduction gears ran practically noiselessly and the fuel consumption was measured at 0.3 pound per indicated horsepower per hour. The ship has completed her first outward voyage to New Orleans. The mean indicated horsepower developed was 3,603 and the speed, with a light draft, 11 knots.

The only other instance of reduction gear being employed in connection with Diesel engines on ships is in the American motor vessel *Libby Maine* but in this case the installation was of low power, totaling scarcely 500 brake horsepower. The *Havelland,* therefore, represents an entirely new development in marine propulsion.

A Novel Diesel Engine

Another novelty in marine Diesel engine plants which has perhaps a more hopeful feature and is indeed a development of some importance is the long stroke motor, the first example



New Burmeister and Wain Long Stroke Diesel Engine for Single Screw Ship

of which has just been installed in a 4,400-ton motor vessel, the *Leise Mærsk,* built in Denmark. The engine is a new Burmeister and Wain design brought out to meet the wishes of shipowners who require single screw installations in their vessels. The chief difference is to be noted in the stroke-bore ratio which exceeds two to one, the stroke for this six cylinder 1,150 brake horsepower engine being 1,300 millimeters and the cylinder diameter 630 millimeters. The usual speed of Burmeister and Wain engines is 115 revolutions per minute but the new type operates at 85 revolutions per minute in order to provide reasonably good propeller efficiency. The construction is somewhat modified, the cylinder supports being different on account of the longer stroke, while there are certain alterations in connection with the valve gear. Apart from these points, however, the design is similar to that of the normal Burmeister and Wain engine and, as might be anticipated, the weight per brake horsepower is greater than that of the higher speed type. The 1,150 brake horsepower long-stroke engine weighs 330 tons, including all the stern gear but excluding the auxiliaries. It must be admitted that this figure is somewhat disappointing in view of the fact that a steam plant inclusive of boilers is practically of the same weight. Engines of this long stroke design are now being built in Great Britain by Harland and Wolff for installation in British single screw motor vessels, which, when completed will give an opportunity for further comparison.

A 20,000-Ton Motorship

Many projects are afoot in England for the construction of large motor passenger liners and there is little doubt that, as soon as trade conditions warrant, vessels of this class will be ordered. The Cunard Line is considering the question of building a 20-knot twin screw Atlantic liner, necessitating the employment of two 12,000 brake horsepower engines which one firm at least is willing to build without any further delay.

Another order which will be definitely placed in the near future is for a remarkable vessel of 20,000 tons gross, in which triple screw Diesel machinery is to be installed. This is to be an exhibition trade vessel specially designed to accommodate exhibits on large stands of 300 different firms, besides which cabins will be provided for an equal number of passengers. Construction will be commenced early in 1922 at the yard of Swan, Hunter and Wigham Richardson, who built the *Mauretania,* and the vessel will sail on her maiden voyage in August, 1923. It is the intention to visit most of the leading overseas ports and the tour will last some eighteen months. The new ship will be 550 feet in length over all with a beam of 75 feet. With her gross tonnage of 20,000 she will be easily the largest motor vessel that has yet been built. High speed is not required, as in a liner, and 13½ knots will be the maximum, corresponding to a machinery installation of about 9,000 horsepower. Three engines of about 3,000 horsepower each will therefore be installed and what will make this vessel still more remarkable than any other oil-engined ship is that the engines will probably be of different makes with the object of giving the machinery itself a greater exhibition value. Although no details are definitely settled it is not unlikely that one of the motors will be built by Swan, Hunter and Wigham Richardson, another by Harland and Wolff and the third by another prominent oil engine manufacturing firm. It need hardly be said that this scheme has attracted a good deal of attention. Although the idea of an exhibition ship is not new, it is stated that this is the first time that a vessel has been specially built for such a purpose.

Larger Semi Diesel Engines

A noteworthy recent development in oil engine construction is the large type of semi Diesel motor. Beardmores have just completed their first 600 brake horsepower four cylinder engine of this class for installation in a large trawler, while Vickers Petters have standardized a four cylinder 500 brake horsepower set and Bolinders are manufacturing engines of equal power. In connection with these sets it is noteworthy that many improvements have been made on the older design and in particular the employment of electric starting plugs is now almost universal. It is obviously an anachronism to have to heat up a bulb by means of a blow lamp with an unguarded flame for some 20 minutes before it is possible to run the engine. With the adoption of the electric starting plug (which consists essentially of a resistance wire wound on an insulated stud) the period required for starting can be reduced to two or three minutes or even less with the largest engines. Bolinders have, moreover, recently brought out a new injection device which they claim gives some 20 percent added power and allows the engine to run without either water injection or the use of compressed air which in the previous type was admitted to the cylinder with the fuel.

$700,000,000 for Harbors and Terminals

By H. McL. Harding*

Every city in the United States, large or small, that has a waterfront is interested in water transportation and is earnestly preparing to have terminals as soon as possible. This is a universal movement in every section of the country. Estimates have been made as to the total amount to be invested in this work, and it is found that the grand total amounts to at least $700,000,000. *Herein lies one of the greatest fields for commercial opportunities, not only for the immediate present but also for a continuing future. Details of some of the outstanding projects, either under way or contemplated, are outlined in this article.*

ONE of the authorities on finance recently said "The surplus money of the country is being invested in water transportation." Half of this investment was for the carriers of the waterborne freight, the other half is now being expended for the all essential ocean and river and harbor terminals. If the land, the approaches for the drayways and railways for these terminals are included, the present investment would be more than half.

To confirm this by definite figures there is presented in the following a list of some of the ports of the United States and Canada, and the authorized anticipated expenditures with the types of terminal improvements and the varied products which will be purchased to provide the necessary work, facilities and equipment. From a comparison between the total waterfront of the different cities and the sections partially improved there can be deduced what will be needed in preparing for future equipment. Such preparation generally requires a year or more to secure the land, make designs and plans and start construction.

The yearly increase in commerce is often the guide which is followed as to extensions. The approximate average of possible freight transference per linear foot per year may be taken as 50,000 cubic feet where there is installed the latest mechanical appliances, otherwise it will not be one-third of this volume.

From the above data and knowing the probable yearly increase in commerce the required frontage to be equipped in future periods can be readily approximated. With the usual physical conditions the cost of the substructures will be about $130 per linear foot. The sums stated in connection with the various ports refer to the work to be done, contemplated or under consideration by the Federal Government, the states, cities, navigation districts, transportation companies, private companies or individuals. Later this list will be greatly extended in scope and detail.

Projects Involved in Terminal Construction

These works embrace harbor construction as breakwaters, moles, dredging, aids to navigation, shore works and facilities including piers, quays, substructures and superstructures. The superstructures require many steel or concrete sheds, numerous warehouses, machine shops and repair shop buildings, office and other structures, as cold storage, also yards, tracks and switches, roadways and often bridges.

The transit shed specifications call for structural steel, rods and bars, floors, roofing, corrugated iron, or concrete, doors, windows, sashes, skylights, tiles, sanitary appliances, plumbing, toilets, water and sewer pipes, valves, meters, sprinkler systems, ladders, switchboards, wiring and paints.

For the warehouses are specified all the materials which form part of such structures, as cement, steel, windows, stairways (steel), roofs, skylights, shutters or wire glass, elevators, chutes, doors (outer and fire), paving, platforms, hoists, piping and plumbing, furnaces, radiators, steel cargo racks, motors, paint, trucks, tiering machines and conveyors.

Much of the work is done by contractors. There are also fuel oil tanks, coal bunkers and grain elevators. Many articles and much of the same material as above would be required for the building of the cold storage plants, repair and machine shops and power plants.

Mechanical Appliances Essential for Operation

Mechanical appliances are essential for the operation of terminals. These comprise gantry and shop cranes of several types, monorails, hoists (fixed and travelling), winches, conveyors (belt and slat types), tiering machinery, hand and power trucks, cargo slings, hooks and nets, ropes and blocks, grab buckets and skips, electric power, wire, switchboards, motors, capstans, locomotives, tractors and trailers, electric charging plants and storage batteries, coal handling machinery, oil and water pumps, containers and scales, wireless apparatus, water and fire hose and tanks with hydrants.

In addition to the terminals themselves, there will be highways, railway storage and other yards; and for long distance transport—motor trucks, and drays, automobiles and garages. Many features connected with terminals are not included in the following figures, although they are contributory to the port development. There may, however, be included dredging plants, sheerlegs, floating derricks, floating cranes, ore and coal barges, fixed derricking hoists of large capacity, tugs, launches, boats, anchors, coaling vessels, coaling elevators, lighters, car floats and fireboats.

Contracts Let by Port Authorities

Orders for the above material and contracts for work are generally given by the port authorities. These officials are interested chiefly in ports, terminals, ships and shipping, and rely almost entirely on marine information, as to where they can purchase and who can supply port facilities and machinery. There should therefore be discussion as to the merits of such products in the papers read by the port authorities.

From times past, the ports of the world have progressed by continual steps, keeping pace with the demands of foreign and domestic commerce, a continuous market. A port with a growing waterborne traffic of miscellaneous goods, having provided correctly designed terminal works and facilities, quickly increases in wealth, population and general prosperity. To this there has been no exception. In addition to the above, the investment in terminals yields an interest return.

Some of the ports of the United States and Canada have been selected to show what are the amounts necessary for the projected or contemplated port improvements for which material or manufactures will be needed, both for initial development and for future extensions. In connection with such ports will be given the sums appropriated or necessary to carry out the contemplated plans.

Most of these ports during the normal times before the war had a waterborne commerce of over 1,000,000 tons and of $30,000,000 in value. Since then these have been of greater tonnage and values. Other smaller ports are added to the list as these are preparing for important improvements.

*Consulting Terminal Engineer, New York.

Half Gantry, Revolving Jib Crane

Attention is first called to the sums already invested in foreign ports and the appropriations for immediate extensions, as shown by the following figures:

Expenditures for Improvement of Foreign Ports

	Expended	*Extensions*
London, England	$200,000,000	$70,000,000
Liverpool, England	125,000,000	45,000,000
Manchester, England	100,000,000	20,000,000
Hamburg, Germany	100,000,000	25,000,000
Antwerp, Belgium	.....	50,000,000
Marseilles, France	.....	25,000,000
Rotterdam, Holland	.....	25,000,000
Melbourne, Australia	.....	30,000,000

Foreign Port Extensions

It is stated from the latest reports of the world's port authorities that every leading port of Europe is preparing to expend from $30,000,000 to $100,000,000 in the near future.

From an examination of various reports and advance information, the following figures may be said to represent approximately the appropriations or sums proposed, or in process of being expended, or for contemplated construction by harbor authorities, transportation companies or private corporations. There is also included money requested from the Federal Government, the states, cities and navigation districts which will eventually be used for harbors, ports and water terminals. The figures as given will show the magnitude and possibility of port development in the United States and Canada. From the raw material of the past, the exports are gradually changing to manufactured products.

Atlantic Port Developments

New York, N. Y.—This is probably the leading port of the world. There are here many projects in contemplation which, if carried out, would require over $150,000,000. At Staten Island, along the Hudson River, at the Gowanus Bay Terminal and along the East River, the present construction will cost about $50,000,000. The Cunard Steamship Company, at Weehawken, the Luckenbach Steamship Company and other interests are building or preparing to build terminals which represent over $60,000,000. Up the Hudson River, land has been purchased at Yonkers for terminals which when built will represent an investment of several millions. There will finally be about 100 terminals along the Barge Canal at various points. There has been completed or in process of construction in New York State barge terminals representing over $25,000,000 in cost. The length of the waterfront of New York City is about 578 miles. The port district includes nearly 900 miles. The following amounts may be expended at once or in the future at the following locations in the New York district: Jamaica Bay, $7,500,000; Newark, N. J., $10,000,000; the Bronx, $500,000. At Jersey City, N. J., the Lehigh Valley railroad is building three piers, each 7,500 feet long, with extensive warehouse and freight handling facilities.

Philadelphia, Pa.—Philadelphia has appropriated $4,000,000 more for its port in addition to the millions already invested. The total length of its direct waterfront is 37.21 miles of which about 17 miles are in actual use. Over 20 miles more can be economically developed, representing a probable future expenditure, including superstructures, of not less than $80,000,000 not including land values.

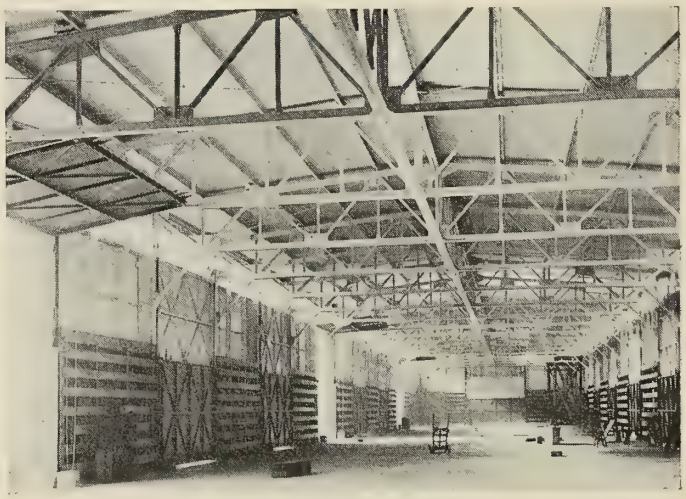
Boston, Mass.—Beside the great sums expended by the French Government, Boston and the State of Massachusetts have invested more than $9,000,000 and will greatly add to this figure by several millions of dollars. The extent of the waterfront is 141 miles. There is a linear frontage of more than 8 miles on a depth of 30 feet at mean low water.

Baltimore, Md.—These has been appropriated for the port of Baltimore $50,000,000 to be utilized for improvements from time to time as directed. The commerce of this port before the war, during normal times, was over 14,000,000 tons yearly valued at more than $439,000,000. The jurisdiction of Baltimore covers 127 miles of deep water frontage of which 43 miles have been improved.

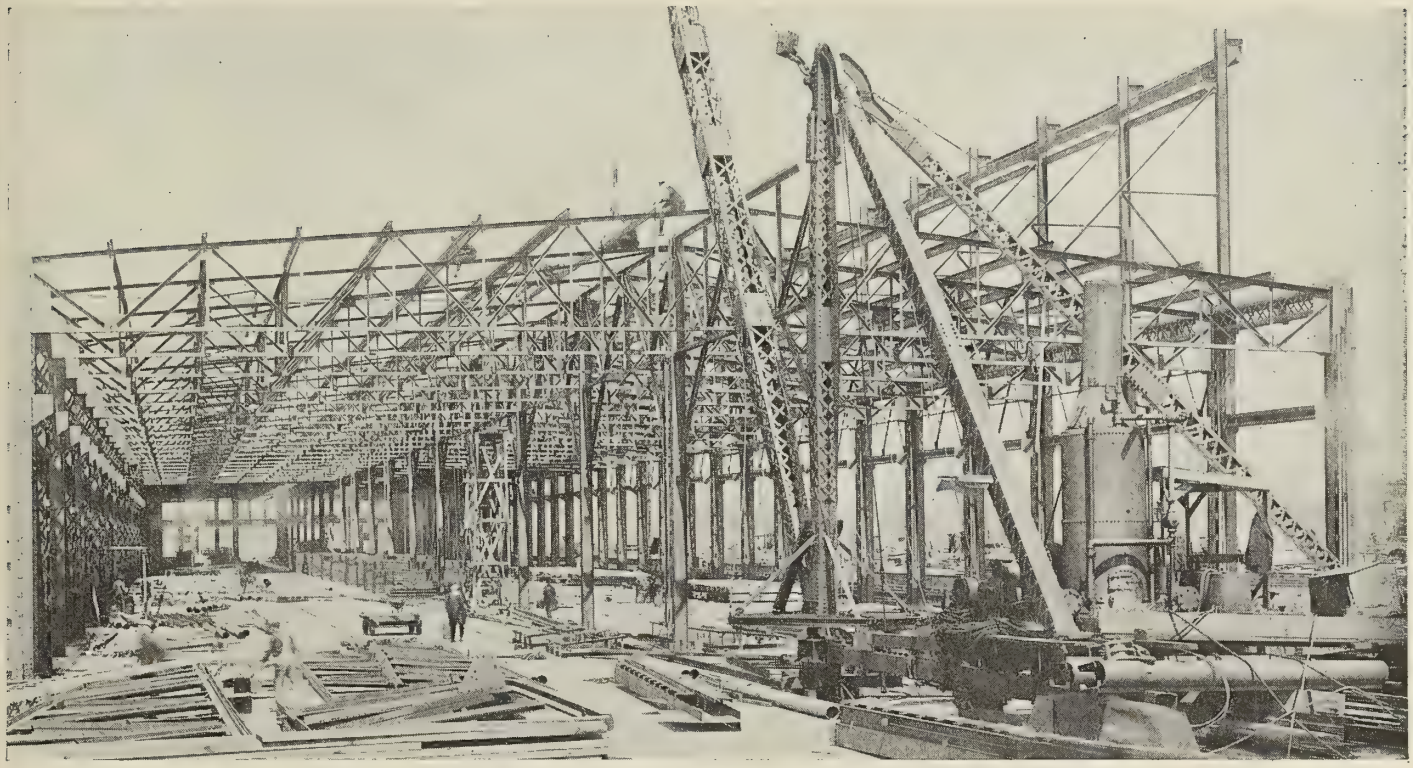
Norfolk, Va.—The appropriation for the improvement of the waterfront of Norfolk is stated to be $5,000,000. The available water frontage is 26 miles. Norfolk is destined to be one of the greatest ports of the United States and the yearly investment will, of necessity, be large.

Wilmington, Del.—The appropriation of $4,000,000 by this city will cover only the investment as per the new plans along the Christiania River. There are 45,600 feet of waterfront available at this port, but only 15,000 feet are in service. The 30,000 additional feet can be readily brought into actual use.

New Haven, Conn.—Here immediate important terminal improvements are contemplated to cost about $1,500,000. Plans and designs have been prepared for the 7 miles of waterfront which will represent an investment during future years of over $20,000,000.



Interior of Pier Shed



Terminal Shed in Process of Construction, Showing Structural Features

Portland, Me.—This principal city of the State of Maine is now constructing a state and municipal pier to cost about $1,250,000. The total waterfront of the three parts into which the harbor is divided is about 8 miles. There will be a continuous development from year to year through more than one generation and the total will aggregate many millions.

Providence, R. I.—This city, which has a state pier and a municipal quay, will provide $1,500,000 for future additions. The waterfront has a length of 28,000 feet of which only one half is in active use. There will be required many mechanical appliances on the present and future quays and piers such as gantry jib cranes, conveyors, hoists and motor trucks.

New Bedford, Mass.—New Bedford has a million dollar pier. The waterfront is 36,800 feet in length. With $100,000 a portion of the waterfront will be improved.

Bridgeport, Conn.—In all probability there will be appropriated by the State of Connecticut about $1,250,000 for this port. Preliminary plans have been prepared. There are here but few permanent public port terminals.

Charleston, S. C.—The total waterfront within the city limits and contiguous is about 15 miles. At this city, during the war, there were constructed by the Federal Government buildings and wharves to the value of $18,000,000. It is expected that the city will at once authorize bonds to the amount of $1,000,000 for permanent port improvements.

Jacksonville, Fla.—This city will add $1,000,000 to its previous investment in port improvements and bonds are authorized. The waterfront is 5 miles in length. Its normal commerce was 2,562,000 tons of a value of $71,244,000.

Terminal Projects at the Gulf Ports

New Orleans, La.—At this, the greatest Gulf city, it is expected that for the canal, quays and structures there will be appropriated about $11,000,000. The total waterfront is 41.5 miles, not including the canal. About 6 miles have been improved.

Mobile, Ala.—There is no doubt as to the future of Mobile, and that it is now a great Gulf port. It is the port of Alabama. It is now preparing to purchase more of its waterfront. There is available for immediate use $500,000 for terminals and there are 8 miles, of which only 4 miles have been improved. About $10,000,000 will be finally expended by the state following the present policy of port expansion.

Galveston, Tex.—At this Gulf city, there will be invested $1,515,000 in the near future. The linear frontage is only 2.5 miles but with the slips included it is 5.9 miles. The adjoining port of Texas City will supplement that of Galveston in a few years.

Houston, Tex.—Houston is making provisions to improve its port and channels from a fund of $1,250,000. The waterfront is about 10,000 feet in length.

Beaumont, Tex.—Beaumont has a bond issue of $500,000 for its port. Three units have been constructed and are equipped with gantry jib cranes and overhead travelling hoists. The port has been earning about 20 percent on the money invested by the city in its terminals. Beaumont is destined to be a great port of Texas.

Pensacola, Fla.—Pensacola has a bond issue of $400,000 which it will now use in waterfront improving. The length of the waterfront is 15,600 feet.

Tampa, Fla.—Tampa is most active in its interest in waterfront commerce and has $1,000,000 to spend. At the city, including slips, the waterfrontage is about 5½ miles.

New Marine Terminals on the Great Lakes

Chicago, Ill.—Besides the millions to be spent at the Chicago waterfront, the estimates for the Calumet and Illiana and South Chicago harbors and terminals, may approximate $58,000,000. This would be spread over the time of several generations.

Milwaukee, Wis.—To complete the terminals in accordance with the new plans already prepared, Milwaukee will require over $25,000,000, but this will be extended over not less than twenty years for completion.

The estimate for the canal and terminals on the canal between Lake Erie and the Ohio river is $60,000,000.

Pacific Coast Ports

From the extent of the waterfronts of the different cities most of which will finally be improved as port terminals,

there can be determined what will be the commercial possibilities at these cities.

This is especially true at the following enterprising cities given as examples:

Portland, Oregon, $15,000,000 for port purposes, 22 miles of waterfront available as terminals of which 5 miles is improved; San Francisco, Cal., $8,000,000 available, waterfront 8 miles, with 5 miles improved; Seattle, Wash., $6,000,000 possible, waterfront 120 miles, improved about 10 miles; Los Angeles, Cal., $4,800,000 available, waterfront 20 miles, improved as terminals 6 miles.

Expenditures at Smaller Ports

The following additional figures indicate briefly the amounts which may be expended at once or in the future at the following locations:

Miami, Fla.	$400,000	Lake Charles, La., dredging	2,750,000
Marshfield, Ore.	250,000	Corpus Christi, Texas	100,000
Dubuque, Iowa	100,000	Aberdeen, Wash.	140,000
Trenton, N. J.	100,000	St. Louis, Mo.	500,000
Canton, Ohio	200,000	Orange, Texas	250,000
Memphis, Tenn.	500,000	Rochester, N. Y.	490,000
Vicksburg, Miss.	500,000	Vancouver, Canada	3,000,000
Venice, Cal.	1,000,000	Toronto, Canada	13,000,000
Helena, Ark.	150,000	Montreal, Canada	2,000,000
Nashville, Tenn.	300,000	Quebec, Canada	1,000,000
Indiana Breakwater	4,000,000	Victoria	4,000,000
Parkesburg, W. Va.	250,000	Esquimalt	1,300,000
Welland Canal, Canada	8,000,000	Prince Rupert	100,000
Columbia, S. C., canal	5,000,000		

The complete list of cities and companies contemplating waterfront improvements is too great to be here given. The War Department will ask for $45,000,000 for ocean and river port improvements. Many other inland cities besides those given are proposing by themselves to provide terminals and are voting money for this purpose. It is a universal movement in every section of the United States. Estimates have been made as to the total amount to be invested, as many of the figures from small towns are not obtainable at present, but will be later. The grand total is estimated to be about $700,000,000.

It may, in conclusion, be stated that every city large or small having a waterfront is interested in water transportation and is earnestly preparing to have terminals as soon as possible. Not only is there great enthusiasm at the ocean ports, but along the inland waterways there is even a greater determination to participate in domestic and foreign commerce through inland navigation by river barges and correctly designed and equipped terminals. The number of the inland and ocean terminals for which provisions should be made may be said to be over ten thousand.

Broadening the Use of Welding in Shipbuilding*

By F. B. Webster

While there has been a rapid growth in the use of welding on the non-structural members of vessels building in the shipyards and a still more rapid growth of its use in repair work, the ambitions of the sponsors of this method of fastening metal parts together will not be satisfied until the practically rivetless ship is the rule rather than the exception. Before this goal can be reached, however, there are many obstacles to be overcome and among these difficulties none is greater than the present method of ship construction which is designed for riveted rather than welded connections.

No more outstanding feature has occurred in the development of shipbuilding during the past few years than the growth of the use of electric, gas and Thermit welding and gas cutting. Welding and cutting have made it possible to do things that could have been accomplished in no other way and in this field they are fully entrenched and bound to develop still further. Welding of the non-structural parts of a ship has many advantages over riveting and has secured the approval of the classification societies, although the extent to which it is used varies with the practice in various shipyards. Welding of the strength members, however, presents the greatest field for development and, although the Navy Department and the classification societies have not as yet given their approval for this class of work, except as an experiment or with experimental notations, the significant fact remains that a welded joint can be made that will exceed in tensile strength or bending toughness any that can be made by riveting.

The comparative efficiencies of riveted and welded joints as determined by Sir Wescott Abell from extensive tests conducted under his direction in 1918 by Lloyd's Register of Shipping are as follows: For a treble riveted overlap, between 65 and 70 percent of the unperforated plate, for the case of welded overlaps, between 70 and 80 percent and for butt welded joints between 90 and 95 percent. These figures, of course, refer to the tensile strength, but, as is well known, the stress at which a material will break down depends largely upon whether this stress is applied steadily or by repetition. In the case of a ship this is particularly important because the strength members are alternately called upon to withstand stresses varying from maximum tension to maximum compression as the vessel passes from the trough to the crest of a wave. In addition to this the direction and intensity of the stresses on a ship vary greatly with the position of the machinery and the amount of cargo in the holds.

With full knowledge of the importance of considering the stresses occurring in actual practice which cannot be reproduced exactly and having in mind the difficulty of testing the workmanship and material in a welded joint Sir Wescott, in addition to determining the tensile strength of welded joints, included in his experiments several different methods of obtaining the modulus of elasticity, the elastic limit of the welding and welded material and other information relating to the ultimate strength and elongation of the welded joints. He also included alternating stress tests under varying conditions and a series of minor tests which included bending and impact. And, in order to ascertain the changes in chemical composition and crystalline structure which occur during the process of welding, complete chemical and microscopic analyses of both the welding and welded material were made.

Although the results of these tests have been fully described in a lecture entitled "Electric Welding for Shipbuilding Purposes" delivered by Sir Wescott before the North East Coast Institution of Engineers and Shipbuilders on November 8, 1918, it is believed that a brief outline of the facts established are necessary as a foundation for a clear discussion of the possibilities of welding from a shipbuilding point of view.

Modulus of Elasticity and Elastic Limit

These tests were conducted on specimens of the maximum size that could be tested in a 300-ton testing machine. Special

*Paper read before the American Welding Society, October 19, 1921.

attention was paid to securing a uniform pull across the breadth of the plate. The loads were increased by gradual increments and careful measurements were made both at the weld and at various points on the solid plate. The results of these tests, as might be expected, showed that there is little or no difference between the modulus of elasticity of the weld and that of the plating. In fact, the readings taken at various points on the plate were generally greater than those taken in way of the weld.

Ultimate Strength

The tests for ultimate strength were also performed on as large specimens as could be tested in a 300-ton machine. This series was included in tests on the ordinary form of overlapped riveted joint for comparative purposes. The results are given in the following table:

STRENGTH OF LARGE JOINTS

Treble Riveted Lap Joints

Thickness, Inches	Diameter of Rivet, Inches	Breaking Stress, Unperforated Plate, Tons Per Square Inch	Strength of Plain Plate, Tons Per Square Inch	Percentage Strength of Joint
.49	7/8	18.9	27.4	69.0
.53	3/4	17.1	27.4	62.5

Lap Weld—Full Fillet—Both Edges

Thickness, Inches	Total Sectional Area, Square Inches	Breaking Stress, Tons Per Square Inch	Strength of Plain Plate, Tons Per Square Inch	Percentage Strength of Joint
.24	6.24	22.4	26.5	85.0
.514	10.02	20.2	28.4	71.0
.75	8.76	18.0	26.6	68.0
1.03	9.78	20.0	25.6	78.0

Butt Weld—Not Strapped

.251	7.0	25.4	26.5	96.0
.505	10.66	27.2	28.4	96.0
.76	9.88	24.4	26.6	91.5
.99	9.90	23.8	25.6	93.0

Alternating Stresses

Two series of tests were performed in these experiments, one on round bars and the other on flat plates. The tests on flat plates were divided into four sets, viz: plain plates, butt welded plates, lap welded plates and plates with joints lap riveted. Here, as in the tensile strength tests, the welded butt joints showed the best results. These indicate that the stress which a plate with a butt weld will endure a large number of alternations is about 70 percent of a similar plain plate, while the corresponding figure for lap welds and riveted laps is about 60 percent. From these tests it was also found that welded joints would withstand a very large number of repetitions of alternating stress up to $\pm$ 6 tons per square inch from tension to compression and vice versa.

Chemical Analysis

Chemical analyses were made of plates, electrodes and deposited material. The observations were that the carbon, silicon and manganese were almost oxidized away from the "filling in" material during the process of welding, that the sulphur and phosphorus remained near the same and that the deposited metal was practically pure iron. It was pointed out that an increased percentage of manganese in the electrode or a coating to protect the molten electrode from oxidization would lessen trouble from this cause.

Micrographic Examination

From a series of microphotos that were prepared to show the junction of the original and deposited metal and also the changes that took place in the structural steel, it was proved that an excellent junction could be made by an experienced workman. Incidentally, it was found that the heat of the welding did not penetrate farther below the surface than 1-16 inch.

From the foregoing it is seen that the tensile strength of welded joints is greater than that of riveted joints. It is also shown that a plate with a welded joint acts as a homogeneous unit at least up to the elastic limit. In the case of alternating stresses it was proved that welded material will withstand a large number of alternations up to a stress of $\pm$ 6 tons per square inch which is sufficient for vessels up to at least 300 feet and probably good for larger vessels. In larger vessels the calculated stresses often exceed 6 tons, but in actual experience the available information indicates that the real stresses are materially less than those calculated under the conventionally assumed conditions.

Cost

With these points in view a material question would be what are the comparative costs of welding and riveting? These, of course, will vary with the type of work under consideration, but, for example, take the attachment of hand rail stanchions to deck plating, which I will quote from a paper presented by H. Jasper Cox at the 1918 convention of the Society of Naval Architects and Marine Engineers:

"1. The positions of the stanchions are lined off and the holes in the base palm marked on the deck plating by the pipe fitters.
"2. The two or three holes, as the case may be, are drilled.
"3. Interior scaffolding is erected by the carpenter at the under side of the deck for the riveters' holder-up.
"4. The stanchion is put in place, packing inserted and bolted up.
"5. Reaming is sometimes necessary.
"6. Two or three rivets have to be driven for each stanchion by a gang, which in most cases cannot be spared from the straight-away work on the decks, shell, etc.

"If electric welding is substituted, the stanchions with their rails inserted are erected in large sections and are welded directly to the deck plating by the operator, who proceeds single-handed with his electric cable from stanchion to stanchion. The water-tightness or oil-tightness of the deck is not affected, and the efficiency of the attachment itself can readily be tested by blows from a sledge-hammer.

"The saving in labor by welding some of the parts in the above list will average more than 60 percent."

In connection with the cost of joining plating it is obvious that there is a considerable saving in marking off, punching, reaming and countersinking, in addition to the fact that a joint requires only one man to weld as compared with four men to rivet.

The American Bureau of Shipping

Before taking up what the writer considers the vital matter which is retarding the broadening of the use of welding in ship construction, it is considered only just to state that the American Bureau of Shipping, our own classification society, has always been prepared to consider on its merits and individual conditions any welding proposition that might be suggested by shipbuilding or repair yards, but to eliminate the difficulty of submitting every little job for the Bureau's approval before execution the Bureau has prepared a list specifying the parts of vessels on which electric or gas welding may be employed subject to satisfactory tests in the presence of a Bureau surveyor which are as follows:

Deck rail stanchions to plating.
Clips for detachable rail stanchions.
Continuous railing rods (joints).
Attaching deck collars (L rings) around ventilators.
Attaching deck collars around smokestack.
Attaching cape rings on smokestacks, pipes, etc.
Attaching galley fixtures to plating.
Attaching bath and other fixtures in officers' quarters.
Attaching cowl supporting rings to ventilators.
Bulwark rail top splicing and end fitting.
Skylight over galley.
Ladders and grating in engine and boiler room and attaching same to plating.
Grab rods to casing.
All stairs and ladders, including rail attachments.
Door frames to casing, hinges, latches, hooks, etc.

Clips for attaching interior wood finish to casing.
Entire screen bulkhead.
Coal chutes.
Butts of water-tight and oil-tight bounding bars on bulkheads or floors in double bottom.
Ventilator cowls.
Stacks and uptakes.
Bulkheads that are not structural parts of the ship, such as partition bulkheads in accommodation spaces.
Framing and supports for engine and boiler room flooring or gratings.
Cargo batten cleats.
Tanks that are not structural parts.
Shaft alley escapes.
Steel skylights over accommodation spaces.
Engine room skylights.
Grab rods on exterior and interior of deck houses.
Deck houses not covering unprotected openings through weather decks.
Reinforcing and protecting angles around manholes.
Joints of water-tight angle collars at frames in way of water-tight flats.
Joints of deck collars, reinforcing and protecting angles, water-tight angle collars at frames in way of water-tight flats, etc., and all other welds which cannot be tested satisfactorily after installation are to be welded and tested prior to installation.

However, if welding is proposed on any other part of a vessel than specified above such proposal must be submitted for the Bureau's special consideration and approval in every case. The American Bureau of Shipping, before permitting electric welding of any kind, will always investigate the facilities of the welding plant both as to the capacity and methods employed and also the skill and thoroughness of the man on the job.

The Bureau has a list of the welding plants which have exhibited their facilities and their products for the approval of the Bureau and certificates have been issued to those plants which have proved themselves capable of meeting the Bureau's requirements in their particular line of work. Upon application for such certification the Bureau will send a surveyor to inspect the plant and upon his favorable report a certificate is issued.

Thermit Welding

With regard to Thermit welding, the American Bureau of Shipping issued instructions to its surveyors in March, 1920, to the effect that subject to the conditions outlined below the Bureau would be prepared to accept Thermit welding of heavy ship parts such as anchors, keels, stern frames, stern posts, gudgeons, rudder posts, stems, propellers, etc. This permission, however, is subject to a complete report before the welding is undertaken containing such information as the name of the ship, a full description including sketch of the part to be repaired, name of welding contractor, manufacturer of Thermit mixture, apparatus, etc.

A Bureau surveyor will supervise the welding operation. He should make certain that ample time is allowed for the weld to solidify and, when cooled, subjected to the following test: Where the collar of the weld is not to be removed a groove should be gouged in the same by a pneumatic chipping hammer and, if on examination of the groove no defects are seen, the weld may be considered sound. When the collar on a weld is machined off it can be judged by the machined surface. In structural work the Thermit weld has proved itself sufficiently satisfactory to warrant the approval experimentally of a new stern frame built up of small forgings joined by Thermit on condition that each forging be tested according to requirements of the rules and that the finished frame be dropped bodily from a height of 10 feet on a hard surface without showing signs of weakness.

Why Development of Ship Welding is Retarded

Notwithstanding the advantages and merits of welding, this art has not been adopted in shipbuilding to anywhere near the extent hoped for by its advocates. To some extent this is undoubtedly due to the fact that the executives in a shipyard are more or less influenced by the men who do the work and these men are more or less uninformed about welding or prejudiced in favor of the old methods. The shipowners are also very conservative when it comes to trying anything new which in their judgment might affect the safety of a ship at sea.

The real cause, however, that is delaying the adoption of welding in the strength members of a ship lies in the present method of design. The modern ship with its angle bars and other shapes is designed for riveting and the faying surface of most of the flanges of these bars serve no other purpose than to provide a means of riveted connection. With riveting a calking edge is of course necessary and the toes of the bars often serve for this purpose, but in welding the calking as well as the connection is in the weld. Before the art of rolling shapes was discovered ships were entirely constructed of plates and flat bars and the flat bars

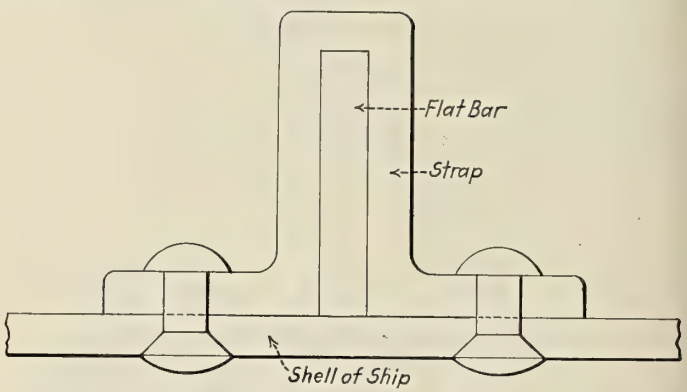


Fig. 1.—Section Showing Method of Fastening Flat Bar Frames to Shell Which Was Used Before the Art of Rolling Shapes Was Discovered

were held in place perpendicular to the plating by straps spaced at frequent intervals as shown in Fig. 1.

If the strap is removed and the junction of the bar and the plate welded we have a section that is as strong as an angle bar plate connection with a more symmetrical neutral axis. Where something stronger than a flat bar and plate section is required the toe of the web of a tee bar or flanged plate or the toe of the flange of an angle bar may be welded to the plate. This is but one indication of a type of efficient welding construction, but its importance is obvious when the amount of weight that can be saved by the omission of faying flanges, and also the beveling of these flanges in the curved portions of the ship, is taken into consideration.

Another custom and prejudice to be overcome is the overlapped and the strapped joint. We have seen from the tests described above that the butt joint is the strongest both for tensile strength and alternating stresses, but in spite of this Lloyd's requires the lap joint. The lap joint is not only

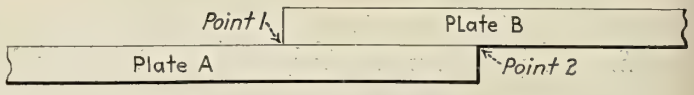


Fig. 2.—Section of Lap Joint in Shell

weaker but, as shown in Fig. 2, it is a positive menace; for any movement in plate A causes that member to act as a lever about point 1 as a fulcrum tending to cause a weakness or rupture at point 2.

Where there is such a difference in the means of fastening as exists between welding and riveting it is but natural to expect that the method of construction for one type is not suitable for the other. And, in spite of the fact that the

(*Concluded on page* 856)

What the Shipping Board Is Doing

Reduction of Expenses—Separation from the Fleet Corporation — Bare Boat Charter Plan — Egyptian Cotton Traffic

CHAIRMAN LASKER of the Shipping Board has announced that on September 15 the number of its employees had been cut to 6,358 and the annual payroll to $12,952,000, as compared with 8,324 employees on June 15 with a total payroll of $15,893,000. These reductions were effected in about half of the departments and further reductions will be made.

Chairman Lasker announced September 17 that the board lost in July $5,700,000 in operations on voyages terminated. Actual cash payments in the month, including payments on past debts, amounted to $9,300,000. In the last year the losses of the board have been estimated at from $10,000,000 to $12,000,000 a month.

The board is endeavoring to get its monthly operating loss down to $5,000,000, Chairman Lasker said. If the board can accomplish that, it was said, it would be doing about as well as possible in the face of the depression in ocean shipping. With the revival of business and complete enforcement of the provisions of the Jones act, however, Chairman Lasker believes that the board would be able to wipe out its operating loss completely. He said the board for the fiscal year beginning July 1, 1922, hoped to keep within an appropriation of $50,000,000 and that the end of large appropriations for the board was in sight.

The following letter to Charles G. Dawes, director of the budget, was made public by Mr. Lasker:

"Confirming our telephone conversation of today, of course, we will have to arrange to keep within the President's commitment of $100,000,000 for the Shipping Board for the present fiscal year.

"We have so far been given $48,500,000 for operations and $25,000,000 for construction, making a total of $73,500,000. It is possible that we will need $6,000,000 or more additional for the vessels now being completed (these vessels being the last of the ships to be constructed for the government). However, if it is decided to recondition the *Leviathan* we will need $8,000,000 to $10,000,000 for that purpose.

"Even though we keep within the $100,000,000 for the year, we will have to go to Congress for an additional appropriation of $26,500,000, having received thus far appropriations of $73,500,000, as accounted for above. The $26,500,000 will be needed to complete vessels now being constructed and to pay losses of operations. We have made a budget of $100,000,000 and are curtailing our operations accordingly.

"However, we wish to call to your attention that we have large receivables and assets which we took over from the prior Shipping Board. We are hoping to collect therefrom $20,000,000. If we are successful in that, we will be able to pay claims up to the amount of the collections, providing Congress votes us the rest of the $100,000,000, and further, providing Congress lifts the ban on our paying claims. But, if Congress does not vote us the balance of the $100,000,000, we will need all the money we can get from collections to operate even on a curtailed basis, and should it be decided to recondition the *Leviathan,* we will not only need the $100,000,000 from Congress but we will need a great share of all the money we will collect to do this reconditioning, and to that extent could not settle with any claimants.

"All of this does not take into consideration the sum of $20,000,000, more or less, due by us from the days of the past to the Navy. When we give the figure of $20,000,000 as due the Navy we want to make clear that the amount involved has never been determined between the Shipping Board and Navy, and at an early date we are going to have a matching of accounts.

"We have always gone on the basis that we would not be asked by the Navy to pay this amount, and, in fact, the Navy has been very indulgent. Should the Navy require this sum for their own appropriations it will be necessary for us to go to Congress for a special appropriation, because we could not possibly operate with $100,000,000 this year and meet the old obligations to the Navy which accrued before the present board ever was brought into being.

"We want to emphasize that the Navy has been most considerate in the premises herein referred to.

"P. S.—Of course, you understand that there are admiralty claims out for $50,000,000 (which may or may not be settled and which may take only a fraction of the $50,000,000); claims and lawsuits of around $200,000,000 for which we have provided nothing in the estimates above given, save for such moneys as we may be able to spare out of the collections above referred to, if any."

Shipping Board and Fleet Corporation Separate

An important development is the recent separation of the Emergency Fleet Corporation activities from those of the Shipping Board, the Board retaining certain supervisory and veto authority over the actions of the Corporation. The members of the Shipping Board resigned as trustees of the Emergency Fleet Corporation and the chairman and vice-charman of the board resigned as president and vice-president of the corporation respectively, following the election of Messrs. Joseph W. Powell, J. B. Smull, W. J. Love, A. J. Frey, Harry Kimball, Elmer Schlesinger and E. P. Farley as trustees of the Emergency Fleet Corporation. Mr. Farley was also elected a vice-president of the Emergency Fleet Corporation. The others had previously been elected vice-presidents of the corporation.

The new board of trustees elected Joseph W. Powell president and general manager of the Emergency Fleet Corporation. T. L. Clear, formerly treasurer of the Isthmian Canal Commission, was also elected treasurer of the corporation. Col. E. A. Shepherd has been appointed comptroller, Mr. Powell serving as a "dollar a year" man.

The purpose of the members of the Shipping Board in resigning as trustees of the Emergency Fleet Corporation, and of the chairman in resigning as president, was, as expressed in the preamble of a resolution adopted by the Board, to give the Shipping Board an opportunity to function under the Merchant Marine Act, 1920, in those broad and constructive powers which must be brought into being, if we are to have an American merchant marine. The Shipping Board itself has powers over America's overseas commerce much like those exercised by the Interstate Commerce Commission over railroads.

The Emergency Fleet Corporation is possibly the largest corporation in the world, Mr. Lasker explained, and for the Shipping Board to direct it would be practically the same thing as having the members of the Interstate Commerce Commission, in addition to their present duties, act as directors of the great railroad systems of the country.

When the new Shipping Board took office it first had to survey its situation and find men of responsibility who could operate the Fleet Corporation's physical properties. It has now done so and feels that it is prepared to turn over the operation of its properties and the liquidation of its physical assets, other than ships, to the Emergency Fleet Corporation. The divorce is complete. Those having business with the Emergency Fleet Corporation will have to deal through the new board of trustees and the corporation officers, who alone will have powers over the assets and the operations of the Emergency Fleet Corporation, with the exceptions noted, though the Shipping Board retains to itself the power to veto cancelling of established lines or the allocation of passenger vessels. With these exceptions and that of ship sales the Shipping Board, as such, beginning October 1, is devoting itself entirely to a study of those sections of the Jones Act which were designed to establish an American merchant marine as a whole.

The administrative functions of the Emergency Fleet Corporation are as follows:

(1) The operation, maintenance, repair and reconditioning of all ships owned by the United States Shipping Board, except that as to operation, no established lines will be discontinued or new lines be established or allocation of passenger vessels be made until the same shall have been confirmed by the United States Shipping Board.
(2) The completion of ships under construction and the sale of ships owned by the United States Shipping Board subject to the policy and as to terms and prices established by the United States Shipping Board.
(3) The care and sale of all surplus materials.
(4) The operation and sale of housing projects, real estate, railroad and other similar property subject to confirmation by the United States Shipping Board before any final contract of sale is made.
(5) Operation and sale of dry docks, any sale being subject to such terms and prices as may be established by the United States Shipping Board.
(6) All accounting of the United States Shipping Board and Emergency Fleet Corporation.
(7) Insurance and matters pertaining to the same.
(8) Operation of all German or War or Navy Department pier facilities as, and if, turned over to the Board, with the exception that no lease of said piers shall be executed prior to confirmation by the United States Shipping Board, and
(9) Leasing and rental of offices, warehouses, docks and storage facilities.

Bare Boat Charter Plan

The promulgation of a bare boat charter plan will not be made for several weeks, and the existing managing agency contract will be continued probably for several months, according to officials of the board. The board had recently announced that it hoped to adopt the bare boat charter plan within 30 days, but it is now said it will require at least several months to work out a new plan. The agency contract is being modified from time to time. A temporary form of bare boat charter has been worked out covering two boats assigned to the Admiral line for Pacific Coast service on the basis of a rate of 50 cents per ton month. These two boats are of 9,600 deadweight tons each. The allocation was approved by the board on September 22 as the result of negotiations with A. F. Haines, vice-president of the Pacific Steamship Company. The charterer will pay all voyage repairs and voyage expenses and the board will carry general insurance and marine insurance. Mr. Haines said the two vessels would be used for carrying grain from the Pacific Coast to Europe via the Panama Canal and that the cargoes would be the first of grain in bulk from the Pacific Coast. If the Admiral line is successful in its venture, it will establish the fact that the government vessels can be operated successfully on such a basis. Later two additional boats were chartered by the Hall-Shaw Steamship Company on the same basis.

To Fight Egyptian Cotton Traffic

The Emergency Fleet Corporation, it is understood, intends to make a vigorous fight, to the extent of cutting rates, if necessary, for participation by American steamships in the movement of Egyptian long staple cotton and other products to American ports. This decision follows the failure of negotiations which have been conducted with representatives of the British lines in England, as explained in the following statement recently given out at Washington by Vice-President W. J. Love:

"As a result of direct negotiations with the Liners' principals in England, the former offered to relinquish to American bottoms 50 percent of the direct sailings between Alexandria and the United States; stating that it was not possible for the Liners to make any arrangements with regard to the indirect traffic, that is, cotton moving to the states with transshipment at an English port, claiming that this was a matter of negotiation between American transatlantic steamers and the Atlantic Westbound Conference, the agreement to run for a period of five years.

"Our reasons for declining this offer were that:

"The offer contemplated giving us 50 percent of the sailings but did not guarantee to us 50 percent of the cotton, and, seeing that contracts were in existence between the British Conference and the cotton shippers for the season 1921-22, and further seeing that there was an insurance disability against American steamers, we were not at all satisfied that 50 percent of the sailings would in any way mean to us 50 percent of the tonnage; we being further advised that the principal owner of one of the British lines was a very large stockholder or connected through subsidiary companies with the cotton presses and gins in Alexandria; also that much of the banking necessary in connection with the movement of this valuable crop was in the hands of financial institutions affiliated with British institutions of a similar character.

"With respect to the indirect movement, the bulk of this business moves on a through rate, and seeing that a number of lines carrying this cotton from Alexandria to the United Kingdom also control lines from the United Kingdom to the United States, we felt it was hardly possible for American boats trading out of Liverpool to get anywhere near a fair proportion of this traffic.

"The five-year proposal likewise was distasteful to us for the reason that it entailed an absolute commitment on the part of the Shipping Board of a character that we felt indisposed to enter into, seeing that heretofore the negotiations for the movement of the Egyptian cotton crop as between the British Conference and the shippers were of a yearly character, simply covering a crop-year movement.

"The existing contracts entered into for the current movement as between the British Conference and the association of shippers specifically provides that no cotton shall move either direct or indirect to the United States in other than British bottoms.

"To have accepted the agreement, therefore, without a written modification of same would have placed us in a very doubtful position. This contract also provides that no Egyptian cotton shipper could sell his goods except on a C. I. F. basis. This means that the cotton is sold, laid down in a United States port, and the routing of same controlled by the shipper, who is dominated by the British Conference in Alexandria. No American consumer of Egyptian cotton, therefore, has the slightest control over the ocean carriage of same, it being reserved, as previously stated, by the shipper under the terms of his contract with the British Conference in Alexandria.

"Another point in this controversy is that according to long custom bids are put in every year by the British Conference in the Spring to the Alexandria General Produce Association for the movement of the crop year beginning the following September. The bids that were put in by the Shipping Board were materially lower than those put in by the British Conference, and yet for reasons still unexplained to us, our bids were thrown out and new bids called for from the British Liners without our knowledge, and when these second figures were submitted by the British Liners they were found to be the same as those originally submitted by us.

"In this connection, it has come to us confidentially that an agreement existed within the Alexandria General Produce Association that the business would be given to the British provided the bids of all companies were the same."

Cabinet Discusses Merchant Marine

The President and his cabinet devoted the entire cabinet meeting on October 7, which lasted for two hours, to a discussion of merchant marine affairs and it is proposed to devote another session to the same subject. No announcement was made of any conclusions reached but it is known that Chairman Lasker has recently submitted to the President at his request an exhaustive report from the Board on the Jones merchant marine act, with particular reference to sections 28 and 34, and it is presumed that this report was the subject of the meeting.

Broadening the Use of Welding in Shipbuilding

(*Concluded from page* 854)

welding used in the construction and repair of locomotives, in the repair of marine boilers and in the construction of the all-welded vessels already built has shown that this method of fastening is reliable, the use of welding in ship construction will not reach its proper development until the designs of ships are modified to suit its characteristics. Whether the future designs for the all-welded ship are along the lines indicated above or not is immaterial, but the advantages that welding possesses are sure to increase its use in the marine field and the thing most needed to hasten this development is an approved and efficient method of welded rather than riveted ship design.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department

Conducted by James L. Bates

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Are Deck Fittings Weakened by Galvanizing?

Q. (1133).—(1) I would like to know if ordinary deck fittings are liable to be weakened by galvanizing? Can you quote actual tests showing that they either are or are not weakened, or can you refer me to published tests? If they are, or may be, weakened by galvanizing, can you explain the reason?

(2) What was meant by the term "screw bolts" used in some old wooden ship drawings and specifications?

(3) What are "jumped knees," a term in Lloyd's Rules for Wooden Ships?

(4) What are "furrens," same source as above?

A. (1133).—(1) Comparative tests carried out upon ¾-inch diameter bar iron intended for use in the manufacture of chain showed that galvanizing does not injure nor change in any way the physical properties of bars of this kind. In the United States destroyer practice deck fittings are frequently galvanized. This practice has successfully stood the test of hard service. The only case in which galvanizing has been considered to exert a weakening effect, so far as the writer's knowledge is concerned, is that of a welded member, such as a chain link. Actual test has indicated that galvanized chain is noticeably weaker than the same chain ungalvanized. This is believed to be due to the weakening action of the acid bath which eats out the slag along the weld line, thus reducing the area of cross section at this point.

(2) A screw bolt, according to Hammersley's "Naval Encyclopedia," is one which terminates in a screw. It is principally used for temporary fastening during construction.

(3) A jump knee is a knee, one of whose arms is terminated abruptly or cut square off short of the proper length because of interference by another member of the ship's structure. Such a shortening results in inadequate connection between the knee arm and the ship structure.

(4) The writer is unfamiliar with the term, "furren." It is suggested that this matter be taken up with Lloyd's Register of Shipping.

Problems for a Marine Engineer

Q. (1139).—(1) What taper must I give an expanding nozzle for the maximum velocity of steam? (In a certain soot blower there are many small nozzles and I am anxious to learn what taper to give them.)

(2) If I had no steam indicator and wanted to set the valves of the main engine (piston or slide) how would I figure the lead, knowing the length of steam ports and diameter of cylinder. How would the speed of the engine affect the lead?

(3) In figuring cubic feet of pipe in cold storage work, do I figure the area inside or outside of the pipe? How many feet (cubic) of pipe are required for a cubic foot of refrigerator space on shipboard, where meat is carried at a temperature of about 20 degees Fahenheit?

(4) Which side of a boiler tube do I measure for heating surface?

(5) What is the United States Steamboat Inspection Service rule for measuring the inside diameter of a corrugated furnace?

A. (1139).—(1) The most efficient angle between the divergent sides of an expanding nozzle in general is between 12 and 15 degrees, though it might be possible to go as high as 20 degrees. To exceed this angle would decrease its efficiency by too rapid expansion, setting up serious eddy currents.

(2) The writer knows no way of figuring the lead of an engine valve where only the length of the steam ports and cylinder diameters are given. The lead is a function of the valve travel and not of the cylinder diameter.

The lead is affected by the piston speed in the following manner:

The larger the cylinder the greater the weight of the moving parts, thus requiring more lead to overcome this inertia. The lead helps to cushion the piston at the ends of the stroke. In small high speed engines the overcoming of the inertia forces is not so important as the necessity of passing as large an amount of steam into the cylinder up to the point of cut-off as possible in the limited time during which the valve is open to admission. This time is increased by admitting steam slightly before the piston reaches the end of its stroke.

(3) The outside diameter of cold storage pipe is used as a basis for calculations. To insure a temperature of 20 degrees F. about 0.4 square foot of brine pipe should be allowed per each two cubic feet of refrigerating space for rooms of 1,000 cubic feet or less.

(4) The dimensions of the heating surface of a boiler tube are measured on the outside surface for both water and firetube boilers.

(5) In the United States Steamboat Inspection Service the practice is to take the least inside diameter of corrugation as that of the furnace.

Power for Towing Barges

Q. (1135).—I am planning to build several barges for use in shallow channels, averaging from 8 to 15 feet in depth. They are to be of 600 tons capacity each and about 150 feet in overall length. The beam is to be 40 feet. What power will be required to tow a single barge at a speed of six miles in still water and with what shape of ends may the best results be expected?

A. (1135).—The question as stated can only be answered in general terms because the specific requirements of the service contemplated have not been enumerated in sufficient detail to make possible a definite answer. The following information partially answers your query and should prove of assistance upon further investigation of your problem.

Seven or eight years ago exhaustive tests on towboats were carried out in the model basin at Ann Arbor, Mich., under the direction of Professor Herbert C. Sadler. The results of these tests covered the effect upon resistance of varying channel depths and different forms of hull. Of the forms tested three types gave generally the best results. All three types had 50 percent parallel middle body and rectangular cross sections in the way of same.

Type 1 in deck plan was faired in at the ends to a width of about half that amidships. In profile it was scow-ended, the cut-up at each end being straight and taking place through about one-eighth the overall length.

Type 2 was rectangular in deck plan. In profile its ends were formed by a radius equal approximately to the load draft and tangent to the bottom and to the forward and after perpendiculars.

Type 3 was given shipshape ends, the water plane coefficient varying from about 0.87 at the deep load line to 0.77 or 0.78 at the bottom plane.

The following conclusions are stated in the report, covering the above tests. Type 3 has the advantage of less re-

sistance than either type 1 or type 2 in the majority of displacements, groupings and depths of water and is, therefore, the most economical type for general service in which all these conditions may be encountered. On the other hand, it is more expensive to build and repair and under certain conditions of service the other types offer less resistance to towing and are also more convenient to operate. If the barges are to be used through long distance commercial traffic, the saving in resistance incident to the use of type 3 will probably more than offset its higher first cost and subsequent higher cost of repairs. If, on the other hand, the traffic involves short distances and frequent breaking of tows and shifting of barges, the greater ease and convenience in making up and breaking the tows and the greater simplicity of form with resultant economy of construction and repair of Nos. 1 and 2 may be sufficient reasons for disregarding the differences in resistance to towing and under such conditions Nos. 1 and 2 might be preferable to No. 3.

For the case suggested it is assumed that the weight of the barge for any of the types without cargo may be taken as 190 tons and the displacement, loaded, 790 tons. Then the draft in the case of type 2 is about 4 feet 10 inches in fresh water. Types 1 and 3 would have drafts somewhat greater in each case than type 2.

At a speed of six miles per hour in a channel of 12 foot depth, the resistance in pounds per ton of displacement is 7.2 for type 2 and 4.4 and 4.1 for types 1 and 3, respectively. The corresponding effective horsepowers are 91, 56 and 52.

The question as stated covers only the horsepower required to tow a single barge and the powers above quoted have been derived upon this basis. In case it were desired to tow groups of several barges, the relative horsepowers required for barges of the three different types might differ considerably from the figures above given.

NEW BOOKS

The Powering of Ships. By J. Bertram Thomas, M. B. E., A. M. Inst. C. E. Size, 6 by 9¾ inches. Pages, 320. Diagrams, 182. Tables, 90. London, 1921: Scott, Greenwood & Son. New York, 1921: D. Van Nostrand Company.

In the discussion of papers containing experimental data on the resistance of ships, read before the Institution of Naval Architects in 1919, attention was called to the difficulty of finding in the mass of available information any particular item required and to the desirability of having something done towards collating and condensing all this information into a simpler and more accessible form. As a result of this incident, the author set about to meet this need by compiling such data in the form of a book in which the experimental results are converted into the constant system of notation in general use by naval architects in Great Britain. Following a brief introductory chapter, the theory of ship resistance is presented in barest outline, followed by an explanation of Froude's constant system of notation and its practical application. The rest of the book comprises the data, conveniently arranged for rapid reference and application, compiled from the results of experiments which have taken place principally in the United States and England during the last twenty years covering the effect upon ship resistance of various modifications or variations in the hull.

Correction.—In the answer to Q. (1132), published on pages 709 and 710 of the September issue, in view of the assumptions made as to the resolution of the force F, the observation made in the last paragraph on page 709 is in error. This paragraph should be omitted in its entirety.

LETTERS TO THE EDITOR

The First Triple Expansion Engine Built in the United States Still in Service

I wish to comment on the first of the one hundred questions which are answered in the October issue, "Who built the first triple expansion engine in this country?"

It may interest you to know that this engine, built by The Bath Iron Works, is in the steamer *Winter Harbor,* which runs from Boothbay Harbor to Wiscassit, Me. The boat makes two round trips every day in the year, Sundays excepted.

Brooklyn, N. Y. A Subscriber.

The Webb Institute of Naval Architecture

Just a little information on Question 44 by "Old Scotch" in the October issue. The institution is no longer known by that name to Webb graduates and undergraduates, as "Webb Academy" was changed to Webb Institute of Naval Architecture in July, 1920. We wish the shipbuilding world to know it as such, for the Institute has a much larger curriculum and gives its students the best shipbuilding education in the country. A junior there would make a very creditable showing on "Old Scotch's" examination.

Brooklyn, N. Y. Edwin T. Day.

Should Direct or Alternating Current Be Used for the Lighting Set?

I have discussed the answer to question 65, "Why should not alternating current be used for the lighting set?" as given on page 756 of the October issue of Marine Engineering and Shipping Age, with an electrical engineer who does not concur in the statement of "Old Scotch." Further discussion of this proposition in the pages of your magazine would therefore be appreciated. C. Hibbard.

Bridgeport, Conn.

Some of the advantages of the use of direct current on board ship for lighting purposes over alternating current are as follows:

One of the most important reasons why alternating current should not be used is the fact that even 110 volts alternating current has been known to be fatal to human life. Induction makes it almost impossible to keep alternating current from becoming grounded, if used for lighting, thus making it more expensive in the cost of installation for the wiring systems.

Direct current must be used in any event for all communication systems such as telephone, bells, signals, enunciators, etc. Storage batteries for wireless must be charged by direct current. Searchlights operated on direct current are more efficient and steady than when using alternating current. Electric telemotors must use direct current.

The flexibility and control of direct current motors cannot be equaled by alternating current motors. Alternating current generators and motors are larger than direct current generator motors of the same voltage. Direct current generators must be used in connection with alternating current for the field excitation of the alternating current generator.

The almost universal use of direct current for lighting purposes on board ship is most conclusive evidence of its vast superiority to alternating current. "Old Scotch."

PERSONAL MENTION

LEOPOLD DOR, of Paris and Marseilles, has been appointed general counsel for the United States Shipping Board in France. Mr. Dor is one of the leading Admiralty counsels of France and will immediately start proceedings in demurrage cases, insurance cases and the like in the Fleet Corporation's interest.

HARRY KIMBALL has been elected vice-president of the Emergency Fleet Corporation in charge of financial matters, having jurisdiction over the treasurer's, collector's and auditor's offices. Mr. Kimball graduated from the United States Naval Academy at Annapolis in 1896 and became connected with the Boston Edison Company. In 1902 he became president of the American Zinc Lead & Smelting Company and in 1916 he was elected president of the Aetna Explosives Company. Later in the same year he became president of the Remington Arms Union Metallic Cartridge Company and after leaving this position was placed in charge of the winding up of the affairs of Gaston, Williams & Wigmore. Recently he has been engaged by the Chase National Bank and other New York banks on special reorganization work in connection with the affairs of various companies. Mr. Kimball is also a trustee of the Emergency Fleet Corporation.

Harry Kimball

REAR-ADMIRAL JOHN KEELER ROBISON, U. S. N., has been appointed by Secretary of the Navy Denby to succeed Rear-Admiral R. S. Griffin as engineer-in-chief of the United States Navy. Admiral Robison was born in Ann Arbor, Mich., November 30, 1870. He graduated from the United States Naval Academy at Annapolis in 1887, later continuing his studies in Paris at the École du Génie Maritime from which he graduated in 1894. He attained the rank of assistant engineer in 1897 and in 1899 was transferred to the line where he passed through the successive grades to his captaincy in 1916. Probably the Admiral's best known work is that of organizing the post-graduate engineering course at Annapolis in 1910. At various times before and during the war he was in charge of the development of torpedoes and conducted aeronautical experiments. After the troop movement started in 1917 he was in charge of convoys until September, 1918, when he was made chief of staff at Cardiff, Wales. He was senior member of the allied commission for taking over German merchant vessels after the armistice and also served as delegate to the peace conference at Brussels in March, 1919, as an aide on Admiral Sims' staff in London and as a representative on various European food commissions. Admiral Robison has specialized in the study of boilers and for a number of years has had much to do in shaping the Navy's policy with regard to boilers. He is also the author of the Navy's first boiler manual.

Rear-Admiral J. K. Robison

JOSEPH E. SHEEDY has been appointed European manager for the United States Shipping Board to reorganize the foreign branches. It will be Mr. Sheedy's duty to systematize the work of the department abroad and eliminate unnecessary duplication, thus effecting a reduction in the personnel. He received his early training as an officer in the Coast Guard (then the Revenue Cutter Service) and was general superintendent for some time of the Inter-Island Steam Navigation Company, Honolulu. In 1916 he became general manager of the Seattle North Pacific Shipbuilding Company. From the Seattle yard of this company he went with the Seattle Construction and Dry Dock Company as assistant to the president, later becoming manager of the Downey Shipbuilding Corporation, Staten Island, New York. While on the Atlantic coast he served as a member of the United States government committee on bulkheads and freeboard; a member of the technical committee of the American Bureau of Shipping; a member of the planning and control committee of the Atlantic Coast Shipbuilders' Association and was also connected with the council of American Shipbuilders.

Joseph E. Sheedy

CHARLES R. PAGE, according to an announcement of President J. B. Levison, has been appointed manager of the Atlantic marine department of the Fireman's Fund and the Home Fire and Marine Insurance Companies to succeed F. H. and C. R. Osborn, who have resigned as of December 31. Mr. Page entered the employ of the Marine Department of the Fireman's Fund in San Francisco twenty years ago following his graduation from Yale University and resigned in October, 1917, when he was appointed a member of the Shipping Board by President Wilson. Upon the organization of the American Marine Insurance Syndicates he became manager of Syndicate "A," now merged into the United States Salvage Association, from which position he is retiring at the end of the year. Mr. Page states that under the new arrangement the service for American vessels will be carried out as formerly and that connections abroad under the Salvage Association will be extended.

Charles R. Page

F. J. McKibbin, formerly with the United States Navigation Company, is now traffic manager of the Transport and Terminal Company, 11 Broadway, New York.

John F. Andrews, until recently manager of the traffic department of the division of operations of the Shipping Board at 45 Broadway, New York, has rejoined the staff of Norton, Lilly and Company.

H. R. Proctor, manager of the Egyptian offices of Messrs. Gray and Hunter, consulting engineers and naval architects, Alexandria, Egypt, has been appointed non-exclusive surveyor to the American Bureau of Shipping.

Robert C. Lee, who acted as general manager of the United States Lines until T. H. Rossbottom took up the duties of that position, has returned to the Moore & McCormack Company, Inc., where he will assist the receivers in straightening out the financial affairs of the old United States Mail Steamship Company, Inc.

Robert M. Watkins has been appointed operating manager of the Emergency Fleet Corporation's vessels in the New York district. He was formerly marine superintendent but this department has been abolished by A. F. Mack, district manager for the Fleet Corporation, who is working out economy and efficiency plans in the personnel of the district. In six weeks by the elimination and consolidation of departments a 25 percent reduction has been accomplished and still further retrenchment will be made by the abolition of unnecessary detail.

Sidney Henry, commercial manager of the United States Shipping Board Emergency Fleet Corporation, has begun the organization of a division of the board which will dispose of surplus material and property other than ships, still in the hands of the Fleet Corporation. Mr. Henry was formerly vice-president of the Baltimore Dry Docks and Shipbuilding Company. The new division will be divided into four departments: materials and sales; transportation and housing; dry docks and marine railways and plants. F. H. Walsh of New Bedford, Mass., will have charge of the material and sales department and Mr. Henry has appointed Fred I. Tucker of Boston, Mass., manager of the plants division.

John E. Bailey, who has been appointed assistant manager, department of maintenance and repairs, of the United States Shipping Board as direct assistant to Commander Gatewood, manager of the department, received his education at Annapolis, the University of Glasgow and the Technische Hochschule, Berlin. For seven years he had charge of naval construction at the Brooklyn Navy Yard and during the war was constructor at the Boston Navy Yard with the rank of captain. After the war he resigned to become assistant general manager of the Baltimore Dry Docks and Shipbuilding Company and continued with this company until the completion of its contracts when he resigned to take up his present duties.

Edwin A. Shepherd recently assumed his duties as comptroller of the United States Shipping Board Emergency Fleet Corporation. Between the years 1891 and 1915 Mr. Shepherd was stationed at various army ordnance establishments in charge of accounting, auditing, production costs, and the like, and from August, 1915, to June, 1917, he was with the Remington Arms Company at Bridgeport, Conn. At this time he was commissioned as an officer in the ordnance department, U. S. A., and made comptroller of the small arms division. He finally attained the rank of lieutenant-colonel and became executive officer of the arsenals and administration division of the ordnance office. After leaving the army he was with the Washington office of the Remington Arms Company and represented various other firms in Washington until his appointment as comptroller of the Emergency Fleet Corporation.

T. L. Clear was recently appointed treasurer of the United States Shipping Board Emergency Fleet Corporation and will assume active control of the office November 1. Mr. Clear was born in Washington and became best known through his connection with the Panama canal commission by putting the financial operation of the canal on a commercial basis. During the war he was commissioned a major in the inspector-general's department of the Army and aided with the control of financial operations of the Expeditionary Force in Europe. He resigned from the Army on October 8, 1921, to assume his new duties with the Shipping Board.

OBITUARY

Henry Lysholm, well-known shipbuilder and engineer, died on September 20, 1921, following several months of failing health. He was in his fifty-sixth year, having been born in Trondhjem, Norway, where he studied civil and mechanical engineering at the Technical Institute. He served his apprenticeship in practical shipbuilding at the Naval Station at Horten, Norway, which was under the direction of his father, who was a naval constructor in the Norwegian Navy. In 1888 Mr. Lysholm came to America and engaged in bridge construction work. Later he went to the Harlan & Hollingsworth shipyard at Wilmington, Del., and came under the notice of Mr. Henry G. Morse. In 1900, when Mr. Morse, as president, organized and started the New York Shipbuilding Company at Camden, N. J., he retained the services of Mr. Lysholm as technical assistant. Mr. Lysholm worked on the preliminary plans of the lay-out of the New York shipyard and proposed building ships on the templating system, similar to that employed in bridge building. Mr. Morse lent hearty encouragement to this scheme which succeeded from the start and Mr. Lysholm was made superintendent of the mold loft, structural drafting room, plate and angle shops, etc. The Lysholm templating method of ship construction soon attracted world-wide attention, and has been almost universally adopted, especially in this country. In 1916, Mr. Lysholm was one of the founders of the Pennsylvania Shipbuilding Company at Gloucester, N. J., and became its general manager. He later became vice-president and general manager of the Pusey & Jones Shipbuilding Company when that firm took over both the Pennsylvania and New Jersey shipyards at Gloucester. The strain of work during the war period undoubtedly undermined Mr. Lysholm's health and it was largely on this account that he gave up active shipyard management in August, 1918. Afterwards he was retained as advisory engineer for the torpedo boat construction work at the New York Shipbuilding Corporation and up to the time of his death he maintained an office in Philadelphia as consulting naval architect. Numerous valuable inventions relating to shipyard construction were made by him, the foremost being the Lysholm plate punching table, whereby the complete control not only of the punch but also of the movements of the plate itself by means of rollers and carriage were brought under the hands of one operator.

Henry Lysholm

Shipping and Ship Operation News

Changes in Steamship Routes — Passenger and Freight Activities—Port Plans and Other Notes of General Interest

Materials and Supplies Valued At $35,000,000 to Be Sold Under New Plan Adopted By Emergency Fleet Corporation

Joseph W. Powell, President, United States Shipping Board Emergency Fleet Corporation, has authorized the following announcement:

The Emergency Fleet Corporation has completed its study of the surplus materials and supplies which were left over from its war activities and has had a complete inventory and appraisal made of all of this material and has now authorized the removal of all restrictions placed on the sale of general materials and supplies. This does not include ships, plants, dry docks and housing and transportation projects, each of which is now being carefully analyzed with the view of adopting definite policies looking toward their disposal.

The aim of the Corporation, in outlining its policy, has been to remove all restrictions and limitations which have tended to make difficult the purchase of Government owned supplies by the general public, corporations, or others not thoroughly familiar with usual Governmental requirements. Each of the District Directors of Sales will be authorized to make cash sales of property in amounts not exceeding $5,000 and we intend to make it just as easy to purchase from one of the Fleet Corporation's stores in quantities not exceeding this amount as it is from the usual corner grocery store. Where the materials run into values greater than $5,000, approval by the Manager of the Material Sales Division, located in Washington, will be necessary but the organization will be such as to permit immediate action on such purchases.

In developing the policy of sales, the Fleet Corporation has made provision not only for sales to the public but for transfer to other Government Departments along the lines laid down by General Dawes, for in transfers of this character the amount of the sale is returned to the Treasury, and, in addition, the Government is saved the difference between the sale value and the price that the Purchasing Department would have to pay if it went into the open market to meet its needs.

The following locations have been designated as the headquarters of the districts in which the country has been divided for the purpose of facilitating sales of the Corporation's surplus property and these storehouses will be organized to make cash sales and to facilitate the disposal of the more valuable supplies:

District	Headquarters	Director of Sales
Northeastern	Wilson Point Warehouse, South Norwalk, Conn.	J. T. Eason.
Eastern	Hog Island, Pa.	G. S. Watt.
Central	1819 West 39th St., Chicago, Ill.	W. J. Leonard.
Southern	U. S. Shipping Board Whse., 3901 Carrollton Ave., New Orleans, La.	H. R. Dillingham.
Southern District.	U. S. Shipping Board Whse., Alameda, Calif.	D. H. Meisenbach.
Oregon	U. S. Shipping Board Whse., St. Johns, Portland, Ore.	T. G. Baird.
Northern Pacific.	U. S. Shipping Board Whse., Tacoma, Wash.	R. D. Caney.

The cost of the material that will be sold under this authority was approximately $125,000,000 and its present appraised value is approximately $35,000,000.

National Association of Practical Refrigerating Engineers

The Twelfth annual convention of the National Association of Practical Refrigerating Engineers will be held at Hotel Lorraine, Philadelphia, Pa., on November 30 and December 1, 2 and 3, 1921.

Levant Arrow Completes Trials

The *Levant Arrow,* built for the Standard Transportation Company at the plant of the New York Shipbuilding Corporation, Camden, N. J., ran her trials on October 12, 1921.

The overall dimensions of the ship are 485 feet in length, beam 62 feet 6 inches, and depth 39 feet 6 inches. She is equipped with three single end Scotch main boilers and one 3,200 indicated horsepower engine, of four cylinder, quadruple expansion, four crank direct acting, surface condensing type. This engine is capable of propelling the vessel loaded to the specified draft, at a speed of 11 knots. She has a displacement of 18,277 tons.

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First Meeting of the Trustees and Council, Emergency Fleet Corporation

This group is responsible for the carrying out of the policies laid down by the United States Shipping Board in its efforts to restore the American flag to a place of supremacy on the high seas.

Photo shows L. to R., Sanford Freund, Special Counsel, William J. Love, V. P. in charge of Traffic, Nathan Smythe, Special Counsel; Elmer Schlessinger, General Counsel; Joseph W. Powell, President, Emergency Fleet Corporation; A. J. Fray, V. P. in charge of operation; J. Barstow Smull, V. P. in charge of Charters; Harry S. Kimball, V. P. in charge of Finance; Edw. P. Farley, V. P. in charge of sales.

Notes of Interest to Steamship Operators

The steamer *Vandyck*, of the Lamport & Holt Line, is expected to arrive at New York next month from Liverpool and will be employed in the service between the United States and South America. The *Vandyck* is a twin screw steamer, 526 feet in length, of 21,000 tons displacement and the propelling machinery consists of two sets of double reduction geared turbines capable of developing a speed of 15 knots. The ship has been extensively equipped for the accommodation of passengers and the handling of cargo, the whole work having been carried out by Messrs. Workman, Clark & Co., Ltd., Belfast.

It is reported from Norfolk, Va., that the wooden steamer *Corone*, recently purchased from the Shipping Board by Pendleton Brothers, of New York, has been brought down from Claremont for repairs at Newport News. It is stated that Pendleton Brothers will soon take over four more wooden steamers, the Potter Transportation Company five, the Union Sulphur Company one and the Clinchfield Navigation Company ten, not including the *Awemsdaw* and *Diana*, which are now being repaired at Newport News for the account of the latter concern.

Should negotiations be consummated for the acquisition of the five passenger steamers of the United States Line, one of the greatest steamship consolidations will take place. It is reported that W. A. Harriman admits that the United American Lines are willing to negotiate with the North German Lloyd for the contract originally made with the United States Mail, notwithstanding the existing agreement between the organization and the Hamburg-American Line. It is thought that the cooperation of these three operators would make the establishment of one of the strongest American passenger lines in the United States, and would greatly upbuild the prestige of the American merchant marine.

It is announced that more than 500,000 barrels of Eastern apples will be shipped to English and continental markets this season. In addition 3,000,000 boxes of apples from the Northwestern states will be shipped overland to New York and other Atlantic ports for conveyance to Europe. The biggest apple shipments ever sent from the Pacific Coast will be transported on the Royal Mail liners from Vancouver, and Seattle, via the Panama Canal, as six of the company's steamers will load at Seattle between October 15 and December 15 to handle a consignment of 300,000 boxes of apples from Washington, Oregon and Idaho.

Bliss Dallett & Co., New York, have issued a new list of sailings of the Red "D" Line, a departure being scheduled each Saturday during the next three months. Commencing October 1, alternate steamers are to call at Mayaguez, the first steamer being the *Maracaibo*. Other stopping ports will include Laguayra, Curacao and Maracaibo. The steamer will touch at Curacao and Mayaguez on her return trip. The steamer *Philadelphia*, scheduled to sail October 8, will stop at San Juan, Curacao, Laguayra and Puerto Cabello, and upon her return, at Curacao and San Juan. The steamers *Zulia* and *Caracas* will also ply in this service.

California fresh fruit will be carried to European ports this month on giant freighters to be operated by the Isthmian Steamship Company, a subsidiary of the United States Steel Corporation, and the Federal Steam Navigation Company, a large British shipping concern. The vessels to be placed on this route are the *Northumberland* and *Wiltshire*, each of 17,000 tons deadweight, and equipped with refrigerator space sufficient to carry 9,000 tons of fresh fruit. The service for the Pacific Coast will include fruit shipment from Oregon and Washington. Both vessels are now in England where they will load a general cargo for the port of San Francisco, Cal., and sail sometime this month. Norton, Lilley & Company, San Francisco, Cal., are the agents for this service.

Following the action of the North Atlantic liners at New York, the Gulf steamship lines conference has lowered rates on grain and grain products to European ports. It is expected that the Montreal conference will shortly adopt rates conforming generally with those established from the North Atlantic. The Gulf conference has established rates to the United Kingdom of 21c. per 100 pounds on wheat, corn and rye; 25 cents on barley and buckwheat, and 28 cents on oats. French rates, 18, 22 and 26 cents on the same products respectively for September and October and 20, 24 and 28 cents for November and December. Rates to Hamburg, Bremen, Antwerp and Rotterdam have been placed at 19½, 24 and 29 cents for September and October, and 21½, 26 and 31 cents for November and December.

The Matson Navigation Company announces the inauguration of a new service from Los Angeles to Hawaiian ports.

Trials of the Peabody burner system installed on the Shipping Board steamship *Independence*, are still being conducted, it was announced recently, contrary to published reports that the tests had been successfully completed. The name of H. B. Taylor, Chief Turbine Engineer of the Board, at 45 Broadway, New York, was erroneously connected with the report.

Providence, R. I., Considered as Starting Point for Atlantic to Pacific Route

It is reported from Providence, R. I., that the Ludwig Lines, which is establishing a service of steamers from Atlantic to Pacific Coast ports, has been seriously considering Providence as a starting point for regular monthly sailings. It is understood that the lines are now carrying lumber from the Pacific Coast to Providence.

The facilities at the Rhode Island port are considered especially good, the harbor having a channel 30 feet deep at mean low water, 600 feet wide, and 27 miles long to the Atlantic Ocean. State Pier No. 1, where several transatlantic liners now dock is 600 feet by 120 feet with a shed 400 feet by 110 feet with 30 feet of water alongside. There are also 66 private wharves of various sizes.

The port is equipped with extensive cold storage for export products, and according to the Providence Chamber of Commerce, which is actively interested in the city's maritime affairs, Providence is the largest New England oil distributing port and has many thousands of square feet of warehouse storage capacity and track storage for several thousand cars.

State Pier at Field's Point is 3,000 feet long, of granite construction, with double tracks its entire length. Several of the biggest oil companies, notably the Standard Oil Company and the Mexican Petroleum Company, have established oil stations of considerable size at the port.

Joint Committee Named to Frame Constructive Policies for American Shipping

A joint committee, representing the three elements of shipowning, building and operating in the merchant marine, has been appointed to frame and recommend to Congress and the Shipping Board further constructive policies in aid of American shipping. This joint committee is established as a result of a conference of owners, builders and operators at the office of the American Steamship Owners' Association, 11 Broadway, New York, on September 16, when concerted action by the three elements was decided on.

For the American Steamship Owners' Association the members of the Joint Committee are:

H. H. Raymond, President, Clyde-Mallory Lines and President of the American Steamship Owners' Association; Frank C. Munson, President, Munson Steamship Line; W. A. Harriman, Chairman of the Board, United American Lines., Inc.; J. R. Gordon, Traffic Manager, Union Sulphur Company; H. F. Alexander, President, Pacific Steamship Company.

For the Council of American Shipbuilders, Inc.: Homer L. Ferguson, President, Newport News Shipbuilding & Dry Dock Company and President of the Council of American Shipbuilders, Inc.; Antonio C. Pessano, President, Great Lakes Engineering Works; H. E. Lewis, Vice President, Bethlehem Shipbuilding Corporation; Henry C. Hunter, Secretary-Treasurer, Council of American Shipbuilders, Inc.

For the United States Ship Operators' Association: Charles H. Potter, President, Potter Transportation Company and President of the United States Ship Operators' Association; Clifford D. Mallory, President, C. D. Mallory & Company; W. D. Benson, Vice President, Frank Waterhouse & Company; Albert R. Lafonta, President, Trosdal, Plant & Lafonta; Matthew Hale, President, South Atlantic Maritime Corporation.

Three Weeks Shipping Exhibit at London Proves Successful, Over 300 Companies Taking Part

Great Confidence Shown in Future of British Shipping Industry—Lectures and Many Important New Appliances Feature Sessions—Situation in Germany Discussed

Despite the prevailing abnormal slump in all phases of the British shipping industry, the International Shipping, Engineering and Machinery Exhibition which was held at Olympia, London, September 7 to 28, was well patronized not only as regards attendance but in respect to the large number of exhibitors. It was a venture requiring considerable courage to promulgate under the present business conditions and its success is a matter of congratulation to the organizers. Practically the entire space in the exhibition hall—the largest in Great Britain—was occupied by 332 exhibitors, most of whom were directly or indirectly interested in the construction and operation of ships. Such a response under present conditions is noteworthy and gives an indication of the Britisher's faith in the future.

The exhibition was conducted under the direction of Sir Charles A. Parsons, honorary president; Lord Weir, Sir Archibald Denny, Sir Eustance H. Tennyson D'Eyncourt, Sir Alexander B. W. Kennedy, Sir Archibald Ross, Colonel R. Saxton White, as honorary vice-presidents, and the organizers were F. W. Bridges & Sons, Ltd.

The exhibition was opened on September 7, in absence of the president, by Captain Charles H. Riall Sankey, president of the Institution of Mechanical Engineers, and Commander Sir Trevor Dawson, vice-chairman and managing director of Vickers, Ltd. In speaking on shipping and commerce Commander Sir Trevor Dawson called particular attention to the use of heavy oil engines for ship propulsion, saying that in six years the number of motor-ships afloat had increased from 290 to 1,447 and that the tonnage had increased more than a million. As regards the economy of this drive, he said that they were about the only ships that were being operated at the present time without a loss. He stated that the present success of British industry depended upon an increase in volume of production and a decrease in the cost.

"Industry," he says, "was thus put in an excellent economic condition to compete successfully in the markets of the world." The average wage paid in Germany he ascertained to be about four marks per man per hour for an 8-hour day, whereas in Great Britain the average wage paid was about seven times that amount under the prevailing exchange rate.

In speaking of the present commercial situation, he said that the greatest question to be settled was undoubtedly that of exchange.

One noteworthy feature of the exhibition was that it introduced quite a number of newly-invented devices. There were several of the well established shipbuilding concerns which were not represented, but for the most part the exhibition may be considered as one of exceeding interest. Among the more important appliances displayed might be mentioned air compressors, anti-corrosion and rust proofings, anti-friction metals, boilers and their accessories, cabin fittings, ship chandlery, cold storage machinery, diving apparatus, various electrical machinery as applied to ship operation, a large number of marine engines, principally internal combustion engines, feed water heaters, hydraulic plant machinery, lifesaving appliances, electrical lighting sets, machine tools of various types applying more particularly to the shipping industry, various nautical instruments, meters and measuring devices, oil fuel burners and their appurtenances, pumps and pumping plants, reversing gears, wire ropes, searchlights, ship fittings, steering gears, superheaters, welding plants, both electrical and oxy-acetylene, electrical and steam winches and wireless apparatus.

There were only seven shipbuilders represented at the exhibition, the greater number of the stands displaying machinery and devices used in connection with the shipbuilding industry.

General View of Marine Show, London, England

Shipbuilding and Shipyard Development

What the Shipyards Are Doing—Dry Dock Notes—Launchings—New Engineering Projects

Seven Million Dollar Order For Six Submarines May Be Placed In American Shipyard by Argentina

Biggest New Construction Contract in Months Awaited by United States Builders—Placing of Order Looked for in Near Future—Two Types of Boat Considered—May Employ 2,000 Workers

A contract for six submarines of either single or double hull construction, involving in the former case an expenditure of approximately $5,400,000 and in the latter, about $7,200,000; and which if placed will probably provide employment for about 2,000 shipyard workers for 2½ years, is the latest prospect for new business attracting attention in eastern marine circles. The Argentine Government, represented by a Naval Commission headed by Captain Fleiss, is understood to be in the market for these boats, and preliminary estimates of cost are being submitted. The Argentine Government is reported as having recently floated a $50,000,000 bond issue, part of the proceeds of which may be used for the purchase of submarines.

According to information received by Marine Engineering and Shipping Age, one of the designs submitted to the commission provides for a boat equipped with twin screws, driven by two Diesel engines of about 500 horsepower each, and two motors for submerged running.

The preparation of these plans, it is stated, also provide for a double hull boat of about 210 feet in length, costing close to $1,200,000 and a single hull type about 185 feet long to be built at an estimated cost of approximately $900,000 each.

In addition to the two motors for submerged running and the surface propulsion equipment, it was learned that other installations for these boats would include powerful storage batteries (about 35 plates each), electric drills, electric lathes, and wireless outfits. It is understood that the vessel will have four torpedo tubes forward and one aft, and mount one deck "wash gun" (about 3 inch).

Unofficial figures give the displacement as follows: Gross submerged tons, 672; net submerged tons, 568; light tons, 485; submerged depth, 200 feet.

Information as to just when this contract will be placed was not available, although it is anticipated that a final decision will be arrived at in the near future.

FLOATING SAFE EXHIBITION

Proves Inventor's Contention When Put Overboard at Providence

Several hundred people witnessed the successful exhibition of a floating safe which was dropped overboard from State Pier No. 1, Providence, R. I., on the afternoon of Wednesday, October 12, with the inventor, Menotti Nanni, of Chicago, locked inside. The safe, which is cylindrical in shape, was fitted inside a huge iron tank, which in turn was lowered into the harbor from a derrick boat and gradually sank beneath the water. The crowd stood breathless as air bubbles came to the surface. With a sudden rush the inner safe shot upward in the center of a small water spout and remained floating quietly on top of the water. It was then hoisted on board a derrick boat, the door unlocked and Mr. Nanni appeared perfectly safe and sound after his brief trip into the harbor.

The demonstration was given by Mr. Nanni to prove the practicability of his invention, which is intended for use on ocean ships for the preservation of valuables at sea in case of disaster to the vessel. The safe has an overall length of 9 feet 8½ inches with an inside length of 8 feet, outside diameter 5 feet 5½ inches, and inside diameter 4 feet 5 inches. It has a displacement (empty) of 112 cubic feet with a capacity of 93.2 cubic feet, and is equipped with eighty safety boxes in which valuables are kept.

It is Mr. Nanni's plan to install his floating safes in a large vertical cylindrical steel casing placed in a well amidships, the top of the well being flush with the upper deck of the ship and covered with a loose-fitting, easily removed cap. The safes are placed one on top of another, the first, second and third class passengers each having a safe for their valuables. The two lower safes serve as a repository for registered mail and for the most precious part of the ship's cargo. Access is gained to the safe through doors provided in both the outer and inner casings at the various decks. It is stated that if a ship equipped with such a system of floating safes should sink, the cover of the well would float off, the water would enter the steel casing and force the safes to rise to the surface, where they would float until picked up by passing craft.

NEW YACHT CONSTRUCTION

Contracts for Five Boats Costing a Half Million to Be Let

Contracts for five yachts, having a total cost of over a quarter of a million dollars, are expected to be placed within the next two or three weeks; bids have been received on two yachts which will cost in excess of $140,000; a 42-foot runabout is under contract and a 101-foot steel houseboat is in course of construction at the Kyle & Purdy shipyard, City Island, New York, the latter to cost about $115,000, according to official information obtained by Marine Engineering and Shipping Age. The total of this work about to be contracted for and already under construction is well in excess of half a million dollars. The firm of Henry J. Gielow, Inc., 25 West 43rd Street, New York City, naval architects and marine engineers, has prepared plans and specifications and is in charge of the work.

Contracts which are expected to be placed in the near future include a 94-foot wooden motor yacht equipped with a 300 horsepower gas engine; a 60-foot runabout also equipped with a 300 horsepower gas engine; a 90-foot full sail auxiliary schooner of wood construction equipped with a 60 horsepower gas engine; an 87-foot steel auxiliary ketch having a 150 horsepower engine to develop a speed of 9 knots, and a 75-foot full sail wood auxiliary having a 40 horsepower gas engine.

Bids have also been received for the construction of a 108-foot steel motor yacht equipped with a 250 horsepower gas engine, and a 37-foot, 40 horsepower cruiser. A 42-foot runabout is under construction in Chicago and the Kyle & Purdy shipyard, City Island, New York, is constructing a 101-foot steel houseboat which will be equipped with two 120 horsepower Diesel engines.

Plans and specifications have been completed for those vessels for which contracts have not yet been placed.

Three Electric Drive Ferryboats To Be Built for City of New York at a Cost of Over a Million and a Quarter

Department of Plant and Structures Completing Plans and Specifications for Most Modern Craft for Manhattan-Staten Island Service—New York Leads Eastern Cities With Installation of Electricity in Municipal Boats

The Department of Plant and Structures of the City of New York has practically completed plans for three electrically driven ferryboats, which are to be built under contract and placed in service between Manhattan and Staten Island.

Grover A. Whalen, Commissioner, has made the following statement in regard to these boats:

"The vehicular traffic between Staten Island and Manhattan, which has been increasing year after year, will make exceptionally heavy demands on the transportation facilities of the city when the new piers on Staten Island are completed and placed in service. To meet these demands I have deemed it necessary that additional boats be built. The requirements of this service are—first, maximum accomodations for trucks and cars; second, the highest practicable speed; and, third, maximum economy in operation.

"The boats which are designed with four runways for vehicles on the main deck and accommodation for passengers on the upper deck will be about 250 feet long. Steel is to be used as far as possible in the construction, including the main deck, the guards and the sides of the superstructure. Certain features that have been adopted on the new City ferryboat the *President Roosevelt* now nearing completion at the yard of the Staten Island Shipbuilding Company, are being incorporated in our design. These include side entrance doors to the upper house, cross seats in the upper cabin, outboard seats along the rails, mechanical davits, etc.

"The most noteworthy departure from the accepted practice of a quarter of a century lies in the type of propelling machinery that has been adopted. In order to secure greater economy in operation than is possible with reciprocating engines, it has been decided to install a steam turbine-driven generator supplying high tension alternating current to a motor at each end of the boat, the latter being direct connected to the propeller shaft. It will thus be feasible to run the two propellers at different speeds which, it is expected, will result in increased propulsive efficiency as compared with the present method of attaching both propellers to one through shaft and revolving them at the same speed.

"We are going to utilize the advantages of high pressure steam, superheated to a high degree and applied to a comparatively small, fast running turbine. Reduction gears were considered for the driving shafts, but discarded as unsuited to ferryboat service. Electric reduction seems to serve the needs of this service admirably, as it is flexible, easily controlled and provides means of quick maneuvering in restricted waters. As compared with a compound, reciprocating engine, a steam turbine will consume only about half the steam and consequently half the fuel.

"There will be no departure from present practice as far as the duties of the pilots are concerned, as all signals will be communicated to the engine room by the usual mechanical telegraphs. Control of the boat will be in the hands of the engineer on watch who will start, stop, reverse, and change the speed of the propellers on signals from the pilot house. We consider that the navigating officers have sufficient responsibility in handling a boat loaded with thousands of passengers across such a body of water as New York Bay without adding to their duties by placing the control of the propulsion motors in the pilot house. This more properly comes under the care of the engineer on watch as he is in close touch with the machinery and knows just what is going on below decks at all times. The advocates of pilot house control have many convincing arguments, but we do not consider such control advisable for our service.

"I wish to say that the question of steam-electric versus Diesel-electric drive has been carefully considered in the design of our new boats, as has also the question of coal vs. oil for fuel. Whereas, we all know that an oil engine is much more economical in the use of fuel than a steam turbine, its use on our ferryboats would introduce undesirable complications. The chances of a breakdown would be increased, which, for boats running on schedule, must be reduced to a minimum.

"Regarding the kind of fuel to be burnt under the boilers, we are designing these boats for coal. There are many points to be considered in deciding between coal and oil, and we have given careful thought to the advantages and disadvantages of each.

"The working out of the design has been entrusted to Mr. Chas. T. Perry, Electrical Engineer, and Mr. Martin G. Kindlund, Naval Architect, both members of the engineering staff of the Department of Plant and Structures. They are striving to produce a ferryboat that will embody the most recent approved ideas as to construction and propulsion and one that will be a credit to our city."

It was estimated the three boats would cost over a million and a quarter dollars.

TO LAUNCH FERRY

The President Roosevelt, Costing $736,400, Nearly Ready

The new Municipal ferryboat *President Roosevelt* will be launched at noon on Saturday, November 5, at the yard of the Staten Island Shipbuilding Company at Mariner's Harbor. The sponsor will be Mrs. Grover A. Whalen. The new ferryboat will be put in service on the Staten Island Municipal Ferry on Thanksgiving Day, November 24th.

This announcement was made to-day by Grover A. Whalen, Commissioner of Plant and Structures, who said:

"This addition to the Municipal Ferry fleet, so urgently needed because of the increase of traffic, will be the finest ferryboat yet built. Its cost is $736,400. It will be a 2,000-ton boat, of the same size and type as the large boats—250 feet long, 66 feet wide, 3,500 horse-power—but a number of improvements suggested by experience in the operation of the present fleet have been embodied in the new boat.

"The *President Roosevelt* will have a capacity of 3,500 passengers and 26 vehicles, with seats for 1,700 passengers. The saloon deck will be open between the stacks, with side doors to the promenade deck in addition to the end doors.

"This is the first ferryboat built by the City of New York since 1914, when the *Mayor Gaynor* was built. Like the *Richmond,* it has been built in New York City, by citizens of this city, and all the work of preparing plans and specifications and supervising the construction has been done by employees of this Department.

"Mayor Hylan, who was responsible for securing the funds for the construction of this boat, will preside at the launching of the *President Roosevelt.*

"The *President Roosevelt* will be a welcome addition to the Staten Island fleet, as it is absolutely needed to permit the Department to maintain the increased service provided in the new schedules. The number of round trips has been increased from 62 to 74 and during a short period, morning and evening, the boats are run on a ten-minute headway, requiring the operation of all the boats, and this schedule will be liable to interruption until the new boat is in service."

Bethlehem Corporation Buys Baltimore Shipyard

According to an announcement by Eugene C. Grace, president of the Bethlehem Steel Corporation, his company has purchased the 48-acre plant of the Baltimore Dry Docks & Shipbuilding Company, thus giving the Bethlehem company additional facilities located on the main harbor of Baltimore and supplementing the plant at Sparrows Point, which means that the corporation will have a complete equipment of dry docks and marine railways to accomplish all kinds of ship repair work at the port of Baltimore. Financial details of the purchase were not disclosed, but it is rumored that the purchase price is about $3,500,000. The property consists of three large ship repair and shipbuilding plants and will be continued in operation on ship repair work.

Million Dollar Contract for Reconditioning the St. Louis Is Under Way By Todd Shipyards Corporation

Famous Steamship to Be An Oil Burner, Equipped With Every Modern Convenience for 'Round-the-World Tour With Exhibits of American Manufacturers

Five hundred men are at work reconditioning the steamship *St. Louis* in readiness for her world trade cruise, beginning in January, 1922, and ending the following December. On this cruise the *St. Louis* will carry the exhibits of 300 to 350 American manufacturers to the four points of the compass.

The contract for the reconditioning of the famous liner was awarded to the Todd Shipyards Corporation by the Anderson Overseas Corporation, owners of the *St. Louis*. The work is being performed at the Robins Dry Dock and Repair Company's plant in Erie Basin and will provide employment for hundreds of shipworkers until after Christmas. The actual cost of the reconditioning has not been stated, but it is believed that it will run close to a million dollars. The contract calls for the ship to be complete and ready for sea in the early part of January.

According to the specifications, the *St. Louis* will be converted into an oil burner by the installation of Todd burners and will be equipped with every modern device known for the comfort and safety of her passengers. The arrangement of the ship will differ to some extent from what it was at the time when she was the crack ship of the American Line. Because of the climatic conditions to be met with during the eleven months cruise, a ventilation system which will serve all the inner and lower rooms in hot countries, and a heating system which will make the same rooms and quarters comfortable in cold countries, has been fully arranged for.

A fully equipped hospital, with isolation ward, operating room, etc., is also included in the plan. On account of one entire deck having been reserved for exhibition purposes, as well as portions of three other decks, great care had to be exercised so that the comfort and safety of the passengers would not be interfered with. One exhibition deck, however, will have an uninterrupted space of about 550 feet long for exhibits. This does not include the automobile section, which will carry practically a New York automobile show around the world.

At the offices of the Anderson Overseas Corporation it was stated that strict instructions were given the Todd Shipyards Corporation that the *St. Louis*, when finished, must be as modern as any ship afloat, as comfortable as the most comfortable, and as safe as it is possible to make her—the pride of the American Nation, whose manufacturers' products she will carry to the four quarters of the globe.

The *St. Louis* was the first 100 percent all steel American steamer ever built, and at that time was the fastest, most modern and the finest ship afloat. She was christened by the former Mrs. Grover Cleveland at Philadelphia, the late President Cleveland and his Cabinet attending.

American Crew Signs on at Lowest Wage Rate Since Prior to the War

As a result of the large number of seamen out of jobs at Norfolk, Va., vessels signing crews here are said to be able to get men at the lowest wage since prior to the war. As an instance, the American steamer *Osage* recently signed on a crew for a long voyage at wages less than those paid before the war. Little difficulty was encountered by the officers of the *Osage* in obtaining a full crew at the lowest scale recorded here for service on a steamer in five years.

The *Osage's* crew was signed on for a voyage to the west coast to load and thence to a Mexican port to discharge. She is operated by Moore and McCormack, of New York.

Where the scale to which the men were asked to agree last summer allows the ship's carpenter $85 per month, the man holding that position aboard the *Osage* signed on for $42.50. The boatswain signed on for $40, where under the scale offered, he would have received $80; the four able seamen are getting $35, against $72.50; two ordinary seamen receive $25, against $52.50; three oilers $40, against $80; six firemen $35, against $75; the first cook $90, against $105; the baker $75, against $90; three coal passers, $25, against $60; two messmen $40, against $60.

Tebo Yard Overhauling Yacht

The firm of Tams, Lemoine & Crane, naval architects, 52 Pine Street, New York City, has in charge the work of overhauling the three-masted auxiliary schooner yacht *Alcyone*, the contract for which was awarded on October 19 to the Tebo Yacht & Basin Company, Brooklyn, N. Y., at a price of approximately $75,000. The *Alcyone* is to have a new steel deck house, two Winton Diesel engines of 300 horsepower each, Westinghouse generator and motor, and will undergo a general overhauling.

WEST CHOPAKA LAUNCHED

Ceremonies Followed by Discussion of New Los Angeles-Orient Line

Marking the completion of four years of the keenest shipbuilding activity and the construction of around 320,000 tons of shipping, costing approximately $72,000,000, the Los Angeles Shipbuilding & Dry Dock Company launched its thirty-fifth and last steel freighter on the United States Shipping Board contract, September 19, 1921.

The freighter, christened *West Chopaka* by Mrs. Fred L. Baker, wife of the president of the company, was the last of that group of 11,000 ton flush deck freighters, in which are included *West Lewark, West Faralon, West Greylock, West Prospect* and *West Chopaka*. These vessels, of which the first three have been chartered by the Williams, Dimond & Company from the United States Shipping Board, are particularly notable for their ease and economy of operation; their exceptional cargo handling facilities, permitting as many as nine separate gangs of stevedores to work at one time; and their very satisfactory speed and fuel consumption.

Following the launching, some three hundred guests of the officers of the shipbuilding company were taken on board the steamship *Harvard* for a cruise around Catalina Island. Among the guests were many of the most representative men in business affairs of Los Angeles, including Meyer Lissner, of the Shipping Board; Joseph Tynan, of the Bethlehem Plant; Harry Chandler, E. P. Clark, Reese Llewellyn, Honorable George E. Cryer, Mayor of Los Angeles, with several of the members of the Los Angeles City Council, Harbor Commission, etc., Sylvester Weaver and Frank Wiggins, of the Los Angeles Chamber of Commerce, with several of its members, Vice-Admiral W. R. Shoemaker, with several officers of the Pacific Fleet, and Colonel H. J. Hatch, in command of Fort MacArthur. During the cruise Fred L. Baker, president of the shipbuilding company, and also president of the Los Angeles Steamship Company, with Erle M. Leaf, vice-president of the shipbuilding company and also secretary of the Los Angeles Steamship Company, held a meeting on board the *Harvard*, attended by several of the prominent men present, to discuss with Meyer Lissner their plans for the formation of a Los Angeles-Orient steamship line, for freight and passenger service. It is understood that their plans are rapidly taking shape and that the Los Angeles Steamship Company, who operate the *Yale* and *Harvard*, may be used as a nucleus for the creation of a powerful steamship company, embracing the highest class of service to Oriental ports, taking advantage of the business connections developed by the Los Angeles Pacific Navigation Company, with which Messrs. Baker and Leaf were also prominently identified.

Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Lake Sabin Awarded, Hoboken, N. J.—At a price of $4,869, the Tietjen & Lang Dry Dock Company, was the successful bidder for repairing the Shipping Board steamer Lake Sabin, bids for which were opened at 45 Broadway, New York, on October 4.

To Install Oil Burners, New York.—The White Fuel Oil Engineering Company has been awarded the contract to supply oil burning systems for the steamships Fort St. George and Monterey at an approximate total cost of $16,250.

The Cable Ship.—It is announced that all bids for the construction of the proposed cable ship for the Western Union Telegraph Company have been received from American and foreign yards. No definite information as to prices submitted or when a decision will be reached is available at present.

Three Contracts Awarded, Shooters Island, New York.—At the opening of bids at 45 Broadway, New York, on September 28, for repairs to Shipping Board steamers, the Standard Shipbuilding Corporation was awarded the steamers Buckeye State for general overhauling at a price of $19,929; the Eclipse at $2,100, and the Great Falls, $409.

Bids for Ferryboat.—It is announced that bids have been submitted for the construction of two new standard type ferryboats for the Pennsylvania Railroad to be used on the run between Camden and Philadelphia. It is believed that some time will elapse before a definite decision is reached as to whether or not construction will go forward in view of the agitation for a bridge between Camden and Philadelphia.

Repair Contract Award, Shooters Island, N. Y.—The Standard Shipbuilding Corporation was awarded the contract for repairing the steamer Centennial State, bids for which were opened by the Shipping Board at 45 Broadway, New York, on October 4. The Standard Company's bid was $9,520. Other bids were as follows: National Dry Dock, $10,714; Robins Dry Dock & Repair, $11,830; Morse Dry Dock & Repair, $15,190.

Launchings, Etc., Chester, Pa.—The Merchant Shipbuilding Corporation announces that two 11,000 ton freighters, being built for the American-Hawaiian Steamship Company will be launched about the middle of November. It is also stated that a list of engineering specialties, to be constructed at the Chester yard will be announced at an early date.

To Overhaul Vessel, San Francisco, Cal.—The former German four-masted bark Walkure, recently purchased by the Robert Dollar Company has been rechristened the William Dollar, and will be brought to the Union Plant of the Bethlehem Shipbuilding Corporation, Ltd., for a thorough overhauling. The vessel is the largest sailing craft of its kind and is capable of carrying 5,100 deadweight tons, or 3,000,000 feet of lumber.

To Repair Motorship, Oakland, Cal.—The motorship LaMerced, which was recently rammed by the Mexican steamer Korrigan III, has been sufficiently repaired by rescue tugs to enable her to be towed to the Moore Shipbuilding Company's plant at Oakland, where she will be repaired. The vessel had a hole several feet wide torn in her starboard side amidships and cut to the waterline. The LaMerced belongs to the Walter S. Scammel Company, and was from San Pedro in ballast, bound north for cargo.

Fast Cruiser Launched, Philadelphia, Pa.—The light cruiser Richmond was launched from the yard of William Cramp & Sons Ship & Engine Building Company, on September 28, for the United States Navy. The new Richmond takes the place in the navy of the old steam sloop Richmond which retired in 1905. She is 555 feet in length and 55 feet breadth, with a displacement of 7,100 tons, and has a speed of 35 knots. She is equipped with twelve 6-inch guns, two anti-aircraft guns, smaller guns and two torpedo tubes. The vessel has accommodations for the carrying of airplanes. She is an oil burner.

Steamer Damaged, Victoria, B. C.—Examination of the Arizonan, in the Esquimalt dry dock, disclosed that the vessel had sustained serious damages when she struck on Kellet Bluff. At least ten bottom plates will have to be renewed and a number of frames straightened. Damage is confined to the starboard side, well abaft of the engine room, and extends to the propellers, the blades of which have been twisted. Two large holes have been ripped through the steel plates at the starboard bilge, while three smaller holes are located further aft and near the keel. Two keel plates are damaged, and the after tanks were punctured.

May Buy Seven Steamers, New York.—Over a million dollars will be spent by the City of New York for the establishment of three ferry lines, one at Hamilton Avenue, another at Atlantic Avenue and a third at Fulton Street. According to present plans, the purchase of seven steamboats and their subsequent reconditioning at an estimated total cost of from $300,000 to $500,000 is expected.

Two steamers are used on the Atlantic Avenue line, two on the Hamilton Avenue line, two on the Fulton Street line, with one reserve boat. It is expected that negotiations will soon be under way for the purchase of these vessels by the city, and it is believed that if they are taken over, considerable reconditioning work will be done.

New River Tug Planned, Paducah, Ky.—The Joyce Watkins Tie Company is reported as contemplating the construction of a sternwheel river towboat for use in southern traffic. The boat will be about 135 feet in length, propelled by a twin compound condensing engine and the boilers equipped to burn oil for fuel.

Pump and Turbine Award, Brooklyn, N. Y.—The Clinton Dry Docks has been awarded the contract for the installation of pumps and turbines on the New York fireboats James Duane and Thomas Willet, bids for which were opened on October 3. The company's figure was $45,890.

Would Increase Passenger Accommodations.—The Pacific Steamship Company (Admiral Line), has asked the United States Shipping Board Emergency Fleet Corporation to make numerous changes in the passenger liners operated between Puget Sound and the Orient so as to increase the third class passenger accommodations to 450 persons. The vessels include the Wolverine State, the Creole State and Granite State, now running in the Manila-East India service. The Golden State, another of the vessels being run by the company has already been changed, having more accommodations and better ventilation. Increasing applications for reservations from Chinese laborers is responsible for the company's request, and the company hopes in this way to assist in solving the problem of transporting these laborers between Manila and the Hawaiian Islands where a shortage of laborers is acute.

Will Overhaul City Boat, New York.—Bids are expected to be invited within the next two weeks by the Department of Plant and Structures of the City of New York for repairing the steamer Patrol, formerly a Police Department boat. It is understood that the contract will include considerable hull work with the possibility of installing an oil burning system. The Patrol is 135 feet long and of 235 gross tons.

To Build Motor Vessel for South, St. Louis, Mo.—The office of the Secretary of the Mississippi River Commission, 1311 International Life Building, will receive sealed proposals until 11 A. M., November 15, 1921, for the construction of one survey and inspection motor vessel. Further details and information may be obtained upon application at that office.

Revising Red "D" Bids, New York.—Latest information obtainable with regard to the proposed two new ships for the Red "D" Line, bids for which were submitted some weeks ago, is to the effect that the lowest bidders for these vessels are revising their figures and will submit new propositions in the near future following which, it is hoped, a decision to proceed with construction will be reached. It is believed that the vessels will cost close to $1,000,000 each.

Robins Yard Awarded Huron Repairs, Brooklyn, N. Y.—The Robins Dry Dock & Repair Company was awarded the contract for repairing the United States Shipping Board steamer Huron, at a price of $21,990. Bids were opened at 45 Broadway, New York, on Wednesday, October 5. The work includes repairs to the boilers, engines, tank tops, hull and electric lighting system. There were nine bidders, the prices ranging up to $33,660 by the Staten Island Shipbuilding Company.

Tanker Launched, Chester, Pa.—The 10,000-ton oil tanker Samuel Q. Brown, built for the Tidewater Oil Company, was launched from the yard of the Merchant Shipbuilding Corporation on Saturday, October 15. The vessel is 424 feet in length, 58 feet beam, 33 feet depth, and has a capacity of 70,000 barrels of oil in her eighteen main cargo tanks. Propulsion is by single-screw and her speed is 10½ knots. The ship will be driven by a triple expansion reciprocating engine developing 2,700 indicated horsepower. The appointments of the ship are modern in every particular, having an up-to-date electric plant, refrigerating plant, sanitary and ventilating arrangements, etc. In addition to the eighteen cargo oil tanks, provision has been made for 60,000 cubic feet of package space.

Engine Contract Award, New York.—The Hooven, Owen Rentschler Company, New York City, has been awarded a contract for two 2,000 horsepower engines which are to be installed in the steamship San Jacinto, which is now undergoing a general overhauling at the yard of the Tietjen & Lang Company, Hoboken, N. J. The contract involves about a hundred thousand dollars.

Large Repair Job, San Francisco, Cal.—It is learned that the steamship Lurline is to be extensively reconditioned and is now in dry dock at San Francisco. It is estimated that the cost of overhauling this vessel will be about $225,000. The steamer Manulani will be placed on the Puget Sound-Honolulu route to take the Lurline's place.

Madawaska Bids, New York.—Bids for the extensive reconditioning of the army transport Madawaska were opened at the Army Base, Brooklyn, N. Y., on September 26, the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., submitting the lowest figures. The bids were submitted in two sections, bid "A" giving the figure for reconditioning work with old boiler repairs, and "B" including new boilers. The company's bids were (A) $167,000, 97 days, and (B) $197,000, 180 days.

Accommodation Repairs, New York.—Specifications are being prepared by the United States Shipping Board, 45 Broadway, New York, for the rearrangement of accommodations on the steamship George Washington to provide closed quarters in the present third class accommodations. The work to be done also includes the installation of 85 electric heaters in those rooms not equipped with steam heat. The electric heaters will be mounted in units one, two and three to a case of 500 watt—110 volts. The Board has appropriated $40,000 for this work.

Derrick Boat.—The United States Engineer Office, Nashville, Tenn., will receive proposals until 11 a. m., November 16, for one steel derrick boat. Further information may be obtained on application.

CONSTRUCTION FOR NAVY

Vessels under construction for United States Navy and their degree of completion as reported September 30, 1921, by the Bureau of Construction and Repair, Washington, D. C., are as follows:

Type	Number and Name	Contractor	Per Cent. of Completion Oct. 1, 1921 Total
		BATTLESHIPS (BB)	
45	Colorado	New York S. B. Corpn.	80.7
*47	Washington	New York S. B. Corpn.	69.7
48	West Virginia	Newport News S. B. & D. D. Co.	62.5
49	South Dakota	New York Navy Yard	34.6
50	Indiana	New York Navy Yard	32.5
51	Montana	Mare Island Navy Yard	27.6
52	North Carolina.	Norfolk Navy Yard	36.6
53	Iowa	Newport News S. B. & D. D. Co.	29.5
54	Massachusetts	Beth. S. B. Corpn. (Fore River)	10.4
		BATTLE CRUISERS (CC)	
1	Lexington	Beth. S. B. Corpn. (Fore River)	25.5
2	Constellation	Newport News S. B. & D. D. Co.	14.5
3	Saratoga	New York S. B. Corpn.	28.4
4	Ranger	Newport News S. B. & D. D. Co.	2.7
5	Constitution	Philadelphia Navy Yard	11.1
6	United States.	Philadelphia Navy Yard	10.7
		SCOUT CRUISERS (LIGHT CRUISERS) (CL)	
4	Omaha	Todd D. D. & Const. Corpn.	94.7
5	Milwaukee	Todd D. D. & Const. Corpn.	92.5
6	Cincinnati	Todd D. D. & Const. Corpn.	87.4
7	Raleigh	Beth. S. B. Corpn. (Fore River)	63.7
8	Detroit	Beth. S. B. Corpn. (Fore River)	68.5
†9	Richmond	Wm. Cramp & Sons Co.	74.
10	Concord	Wm. Cramp & Sons Co.	68.
11	Trenton	Wm. Cramp & Sons Co.	51.
12	Marblehead	Wm. Cramp & Sons Co.	46.
13	Memphis	Wm. Cramp & Sons Co.	40.

*Battleship No. 47 Washington launched Sept. 1, 1921.
†Scout (light) cruiser No. 9 Richmond launched Sept. 29, 1921.

	AUXILIARIES	
Repair Ship No. 1, Medusa (AR1)	Puget Sound Navy Yard	69.3
Dest. Tender No. 3, Dobbin (AD3)	Philadelphia Navy Yard	66.3
Dest. Tender No. 4, Whitney (AD4)	Boston Navy Yard	34.9
Sub. Tender No. 3, Holland (AS3)	Puget Sound Navy Yard	21.5
Aircraft Tender, Wright (AZ1)	Tietjen & Lang	92.
	PATROL VESSELS	
Gunboat No. 22, Tulsa (PG22)	Charleston Navy Yard	70.8

Authorized but not under construction or contract.
(1) Transport No. 2.

	DESTROYERS	
338	Wasmuth	Mare Island Navy Yard 99.5
339	Trever	Mare Island Navy Yard 97.5
340	Perry	Mare Island Navy Yard 75.3
341	Decatur	Mare Island Navy Yard 70.2

Destroyers authorized but not under construction or contract.
(12) Nos. 348 to 359 inclusive.

		SUBMARINES	
115	S-10	Portsmouth, N. H., Navy Yard	93.9
116	S-11	Portsmouth, N. H., Navy Yard	91.8
117	S-12	Portsmouth, N. H., Navy Yard	91.
118	S-13	Portsmouth, N. H., Navy Yard	87.6
123	S-18	Electric Boat Co. (Quincy)	97.
124	S-19	Electric Boat Co. (Quincy)	96.5
125	S-20	Electric Boat Co. (Quincy)	98.5
126	S-21	Electric Boat Co. (Quincy)	94.9
127	S-22	Electric Boat Co. (Quincy)	95.8
128	S-23	Electric Boat Co. (Quincy)	94.
129	S-24	Electric Boat Co. (Quincy)	93.
130	S-25	Electric Boat Co. (Quincy)	93.5
131	S-26	Electric Boat Co. (Quincy)	92.4
132	S-27	Electric Boat Co. (Quincy)	91.
133	S-28	Electric Boat Co. (Quincy)	91.6
134	S-29	Electric Boat Co. (Quincy)	90.5
136	S-31	Electric Boat Co. (San Fran.)	97.5
137	S-32	Electric Boat Co. (San Fran.)	95.9
138	S-33	Electric Boat Co. (San Fran.)	99.2
139	S-34	Electric Boat Co. (San Fran.)	95.3
140	S-35	Electric Boat Co. (San Fran.)	92.6
141	S-36	Electric Boat Co. (San Fran.)	89.7
142	S-37	Electric Boat Co. (San Fran.)	87.5
143	S-38	Electric Boat Co. (San Fran.)	81.6
144	S-39	Electric Boat Co. (San Fran.)	78.1
145	S-40	Electric Boat Co. (San Fran.)	77.
146	S-41	Electric Boat Co. (San Fran.)	78.7
153	S-42	Electric Boat Co. (Quincy)	74.4
154	S-43	Electric Boat Co. (Quincy)	74.9
155	S-44	Electric Boat Co. (Quincy)	73.
156	S-45	Electric Boat Co. (Quincy)	73.5
157	S-46	Electric Boat Co. (Quincy)	72.1
158	S-47	Electric Boat Co. (Quincy)	71.4
159	S-48	Lake T. B. Co. (Bridgeport)	97.5
160	S-49	Lake T. B. Co. (Bridgeport)	95.3
161	S-50	Lake T. B. Co. (Bridgeport)	91.6
162	S-51	Lake T. B. Co. (Bridgeport)	88.4
		FLEET SUBMARINES	
60	T-2 (SF 2)	Electric Boat Co. (Quincy)	99.3
163	V-1 (SF 4)	Portsmouth, N. H., Navy Yard	4.7
164	V-2 (SF 5)	Portsmouth, N. H., Navy Yard	4.7
165	V-3 (SF 6)	Portsmouth, N. H., Navy Yard	4.7

Note: Submarines authorized but not under construction or contract:
Fleet submarines (6) Nos. 166 to 171.
Neff submarine (1) No. 108.

SHIPYARDS AND DRY DOCKS

New Shipbuilding Company, Miami, Fla.—The Marine Service Company is reported as being a new shipbuilding company recently organized by Louis Marco, C. T. Roberts, and J. E. Sheldon, with a capital of $25,000.

Power Plant, Jersey City, N. J.—Bids are being received by the Vulcan Iron Works, Hudson Street, for a new power plant to replace the structure recently destroyed by fire. The estimated cost is about $40,000.

Floating Dry Dock, Vancouver, B. C.—Plans are under consideration for the construction of a 20,000-ton dock, but all arrangements have not as yet been completed. Announcement regarding the building of this dock is expected within a week or so.

Purchase Plant, San Francisco, Cal.—It is announced by George A. Armes, president of the General Engineering Company that his concern has purchased the holdings of the Triangle Engineering Company, all of the equipment of which will be installed in the plant of the General Engineering Company, which will engage in ship repairing and construction.

PORT IMPROVEMENTS

Wharf, Kahului, T. H.—It is reported from Honolulu that a contract for the construction of a territorial wharf has been let on a bid of $580,000.

Dredging Equipment, Philadelphia, Pa.—The Department of Wharves, Docks and Ferries, Bourse Building, plans the purchase of additional units for its dredging plant, to cost about $500,000. N. L. Stamm, Bourse Building, is engineer.

Bonds for Port Improvements Sold, Tacoma, Wash.—The Port Commission has sold bonds in the amount of $900,000 to a Tacoma firm at a premium of $10,350, the money to be used for the construction of a transit shed and other improvements.

Pier Improvemnts, Etc., Montreal, Canada.—The chairman of the Administrative Committee is receiving bids for repairing guard piers at $24,000; shore cribs, $24,000; inlet through entrance dam, $10,000; overflows, $10,000; and coping, $97,000.

Wharf, New Orleans, La.—The Board of Port Commissioners is planning to repair the Celeste Street wharf, which is to have a steel superstructure, involving the expenditure of about $600,000. H. M. Gallagher, 1 Canal Street, is chief engineer.

Piers, Holmesburg, Pa.—The City of Philadelphia, Pa., plans the completion of the piers and grounds at the Home for Indigent at Holmesburg, to cost about $50,000. W. F. Noller, Holmesburg, is engineer.

Docks, Etc., Windsor, Ont., Canada.—The International Ferry Company plans to build docks and offices at the ferry from private plans and desires prices on all materials required for their building and completion. It is estimated that this project will involve the expenditure of about $150,000.

Ferry Houses, Etc., Palmyra, N. J.—G. F. Sale, Liberty Building, Philadelphia, Pa., has let a contract for the construction of a timber and concrete ferry landing or wharf 60 feet wide, 180 feet long, with appurtenant bridge, etc., at the foot of Cinaminson Avenue, for the Tacony Ferry Company, to the S. E. Browne Company, 90 West Street, New York. The work amounts to $38,491.

Harbor Improvement, Corpus Christi, Tex.—The City of Corpus Christi and Nueces County Commissioners, Texas, plan the establishment of a navigation district; the improvement of the deep water harbor and to equip the port with wharfage and terminal facilities. F. A. Tompkins is county auditor, and C. J. Howard is city engineer.

Pier Superstructure, Philadelphia, Pa.—The Department of Wharves, Docks and Ferries, Bourse Building, has let a contract for building the superstructure of Chestnut Street Pier 4 to the J. S. Rogers Company, Drexel Building, Philadelphia, at a cost of $298,700.

To Improve Port Facilities, Hilo, T. H.—To take care of an expected increase in shipping, $500,000 will be spent immediately in the construction of additional wharf and berthing facilities at Hilo, according to a recent report. A marked increase in the production of canned pineapple and sugar on the Island of Hawaii is predicted.

Terminal Improvements Urged, Tampa, Fla.—In a recent report to the City Commissioners the urgent necessity for the early construction of Tampa's municipal terminals was pointed out, and it is believed that a bond issue of about $1,000,000 will be made available by the city for improving the harbor. The Government officers report that the 27-foot channel will soon be completed and that Tampa will have to provide facilities to care for the increased business resultant from the ability of deeper draft vessels to enter the port.

$5,000,000 Development for Norfolk, Va.—The Norfolk Port Commission has just advised the City Council that the port development work being planned by the Commission will cost in the neighborhood of $5,000,000. Barton Myers, chairman of the Commission, has recommended that the Council consider the question of a bond issue for these improvements for submission to the voters of this city at the November election.

Plans have been drawn, under the direction of the Commission, for pier, warehouse and grain elevator facilities, which will cost upwards of $4,000,000, and a small boat terminal is also contemplated. The piers, warehouses and elevators will be constructed on property now owned by the City of Norfolk, fronting a half mile on Hampton Roads.

Harbor Improvement Plans, Jacksonville, Fla.—It is learned that recommendations made by the rivers and harbors commission of the Chamber of Commerce, with reference to harbor improvements in Jacksonville, have been approved by City Commissioner W. A. Evans, who suggested that the city commission hold a special session to consider the recommendations of the committee and also take early steps to engage the services of expert and experienced engineers to prepare the plans and specifications for, and superintend the construction of, the proposed developments which include the dredging to depth of channel and maintenance; coal and phosphate loading facilities and storage; new pier with shed permitting greater storage capacity, south of the present piers; ladder track on the north side of Pier No. 2; inland storage warehouse for "time cargo" east of Talleyrand Avenue (near the water); additional cotton warehouse space east of Talleyrand Avenue; additional electric trucks for handling cargo to ship side; concerted plan of publicity, and the employment of an experienced commercial agent who knows traffic and rates both rail and water.

New Port Terminal, Jersey City, N. J.—Among the extensive port and terminal improvements now under way at Jersey City, the Lehigh Valley Railroad's program may be said to be one of the largest. This company is constructing a terminal which will serve the railroads and at the same time provide excellent deep water connections with three piers, each to be 7,500 feet long, carrying extensive trackage, warehouse and freight handling facilities in the Greenville section of Jersey City on New York Harbor. The first unit of the terminal for which a 35-foot channel is now being dredged out to deep water will be a 3,500-foot wharf near the foot of Chapel Avenue, Jersey City, providing facilities for the handling of general heavy freight and for unloading ore from boats into cars at the rate of one car per minute. Preliminary plans include storage and classification yards, engine terminal, a large grain elevator, and three piers, the entire terminal to cover about 635 acres and to provide a total dock length of about six miles. Almost the entire length of the south side of the first wharf unit will be filled in practically level with the Pennsylvania Railroad property to the south. All tracks will be carried on solid fill. The channel now being dredged extends along the north side of the wharf site 300 feet wide to the Government bulkhead line, from which it tapers to 250 feet extending out to deep water from this line. When pier 2 is constructed the channel will be widened between the two piers to a maximum of 550 feet. The dredging of about 12,000,000 cubic yards will be necessary for the carrying out of this project, while dredging for the present slip involves the removal of 3,000,000 yards. A large portion of the hydraulic fill from dredging will be required in building up to the necessary elevations for gravity yard rises, some of which will be about 35 feet above mean low water. Gantry cranes and other conveying machinery will be installed on the piers. The warehouses will be of concrete and steel.

New Steel Pier, Jersey City, N. J.—A new steel pier to replace the old wooden pier destroyed by fire a few weeks ago will be constructed by the Erie Railroad Company, at the foot of 12th street. Freight handling and other mechanical equipment will be installed on this pier, the entire project to cost more than $500,000.

Docks and Transit Shed, Houston, Texas.—The restruction of the cotton docks on the north side of the basin will soon commence. The work includes the enlarging of the docks and the building of a transit shed 100 by 800 feet, with two tracks alongside.

New Dock and Equipment, New York.—The proposed new dock to be built on the Hudson River, north of Spuyten Duyvil Creek, by the Department of Docks, will be equipped with the most modern freight handling and conveying machinery. This dock is estimated to cost about $75,000. Murray Hulbert, Pier A, North River, New York, is dock commissioner.

Large Port Contract Awarded, Galveston, Tex.—The United States Engineer Corps recently awarded to Messrs. Charles Clarke & Company a contract for the construction of four spur dikes to be built from the east jetty of the port out into the channel, thus greatly improving the entrance to the harbor of Port Arkansas. This job amounts to $115,000.

Floating Dry Dock, Vancouver, B. C.—It is reported that if the government permits a subsidy, the port of Vancouver will have a dry dock within a year that will be able to handle any ship entering the port. A floating dry dock has been urged for this port for several years and has been reported upon favorably by a committee of the Board of Trade which has investigated the question of a dry dock for this port.

Charleston, S. C., Terminal Damaged by Fire.—Damage exceeding $1,300,000 was wrought by the recent fire at the Columbus Street terminals of the Charleston Terminal Company, Charleston. It is reported that materials in storage worth about $1,250,000 were destroyed, and that the damage to the wharf and warehouses amounted to several hundred thousand dollars. The company's machine shop, coal hoisting apparatus and other appurtenances were destroyed.

GOVERNMENT WORK

Foundation, San Diego, Cal.—Specification 4528. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans the foundation for a dispensary and post exchange.

Cooling Tank, Norfolk, Va.—Specification 4523. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a cooling tank at the radio station.

Dispensary, San Diego, Cal.—Specification 4527. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a dispensary at the Marine Corps Base.

Fire Protection System, Washington, D. C.—Specification 4525. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to install a foam fire protection system.

Radio Buildings, Bar Harbor, Maine.—Specification 4521. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans the construction of radio buildings.

Storehouse, Pearl Harbor, T. H.—Specification 4504. The Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids until December 7 for a one-story storehouse.

Lock Planned, Fayetteville, N. C.—The United States Government plans the construction of a third Government lock on the Cape Fear River, to cost about $200,000.

Dredging Contract Award, Detroit, Mich.—The United States Engineer has let a contract for dredging and rock excavation in Livingston Channel, Detroit River, to the Dunbar Dredging Company, Detroit, at a price of $414,500.

Dredging and Filling, San Diego, Cal.—Specification 4485. The Bureau of Yards and Docks, Navy Department, Washington, D. C., has let a contract for dredging and filling in and repairing the Naval Base, to the San Francisco Bridge Company, 14 Montgomery Street, San Francisco, at $.2015 per cubic yard, and 200 days.

Machine Shop, Pearl Harbor, H. T.—Specification 4464. The Bureau of Yards and Docks, Navy Department, Washington, D. C., has let a contract to C. A. Blume, 1309 Sixth Avenue, San Francisco, Cal., for the construction of a one-story machine shop, 181 by 520 feet, with a steel superstructure, at the Naval Station. The price is $45,825, and the work will be completed in 170 days.

Removal of Wreck, Glen Cove, New York.—The United States Engineer Office, First District, New York City, Room 710, Army Building, 39 Whitehall Street, New York City, will receive bids until 12 noon, November 9, for removing the wreck of the tow-boat Carrick No. 5, sunk in Hempstead Harbor, at the south side of Glen Cove Landing. Specifications furnished upon request by those desiring to submit a proposal for this work.

Watertube Boilers Wanted, Memphis, Tenn.—The office of the District Engineer, Mississippi Dredging District, P. O. Box 1017, will receive sealed bids until 3:30 P. M., November 16, 1921, for furnishing and delivering two watertube boilers for United States dredge Beta, and three watertube boilers for United States dredge Henry Flad. Further information may be obtained upon application.

NEW INCORPORATIONS

The Ottoman-American Steamship Company, Wilmington, Del., has been incorporated with a capital of $500,000 to own and operate boats.

The Ludwig Lines, Inc., 50 Pearl Street, New York, have been incorporated with a capital of $100,000 by D. K. Ludwig to carry on a navigation business.

The Fair Oake Steamship Corporation, Wilmington, Del., has been incorporated with a capital of $100,000 to own and operate boats, etc.

The National Pump Company, Wilmington, Del., has been incorporated with a capital of $250,000 to manufacture pumps and pumping machinery.

The Bay Transport Company, San Francisco, Cal., has been incorporated with a capital of $500,000.

The Boston Shipping Company, Boston, Mass., has been incorporated with a capital of $50,000 to carry on a transportation business.

The Ottoman-American Steamship Company, Wilmington, Del., has been incorporated with a capital of $500,000 to own and operate boats.

The Keaston Navigation Company, Inc., Manhattan, N. Y., has been incorporated with a capital of $50,000 by M. Eisner, 241 Utica Avenue, Brooklyn, N. Y.

The Daphne Boat Company, Daphne, Ala., has been incorporated with a capital of $30,000 by George A. Mitchell and C. E. Carter, to establish a transportation system.

CAPITAL INCREASE

The Tri-State Navigation Company, Atlanta, Ga., has increased its capital from $20,000 to $100,000. Homer R. McClatchey is secretary of the company.

BUSINESS OPPORTUNITY

Opportunities for foreign trade announced by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., include the following:

31. An engineer in Norway desires to secure the agency for the sale of motor boats and marine engines for fishing and pleasure. Quotations should be given f. o. b. New York.

Interested firms should apply for additional details to the Bureau, mentioning the reference file number.

FOREIGN ACTIVITIES

New Floating Dock, Blythe, Eng.—A new floating dock has been acquired by Riston's Shipbuilding & Engineering Company, Ltd. The dock is capable of lifting vessels up to 275 feet in length.

To Be Oil Burners, Elswick, Eng.—It is reported that Whitworth & Company, Ltd., Elswick, England, has procured a contract from the Cunard Steamship Company for the conversion of all their coal burning steamers into oil burners.

Motorships, Bristol, Eng.—The keel for the third motorship contracted for by the British India Steam Navigation Company has just been laid at the Albion Dockyard of Messrs. C. Hill & Son. The vessel will have a deadweight capacity of 4,500 tons. The two other combined cargo and passenger vessels being constructed for the same company at this yard are well under way.

New Shipping Company, Valparaiso, Chile.—The Chung Hua Navigation Company has been organized by a number of Chinese residents at Valparaiso with a capital of $4,000,000, for the purpose of running a steamer service between Hong Kong and Chile, via Shanghai, Honolulu, Panama and Peru. At a later date the new line proposes to establish another service from Hong Kong to New York.

Coal Ships, Hamburg, Ger.—It is reported that the Deutsche Werft has received an order from the firm of Sauber Brothers, Hamburg, for the construction of a coal steamer of 4,000 tons capacity. The vessel will be turbine driven and when ready for service will be used in the transportation of coal from England to Hamburg.

Deep Sea Fishing Steamers, Hamburg, Ger.—The German sea fisheries A.-G. in Cuxhaven have placed an order with the Reiherstieg Schiffswerften for the construction of fifteen new deep sea fishing steamers. The firm of Petersen & Alpers, Hamburg, have placed an order for the construction of a cargo steamer of the newest type, to be fitted with machinery of 600 horsepower.

Naval Dockyard to be Extended, Sourabaya, N. E. I.—It is learned that the sum of 5,500,000 florins is to be expended by the Netherlands East Indies Government during the present year for the further improvement of the harbor. New docks, wharves and piers in addition to other works are planned.

Deep Water Dock, Brest, France.—Plans for the construction of a deep water dock have been authorized by the Minister of Public Works. The estimated cost of the project is about 17,000,000 francs, which will include a quay to be 245 metres in length, with a berth depth of 12 metres, and equipped with four electric cranes, each having a lifting capacity of 8 tons.

Dry Dock, Manila, T. H.—According to recent reports plans are under way by the Honolulu Iron Works and the Earnshaw Shipways for the construction of a marine railway or dry dock of 8,000 tons.

Dockyard, Shanghai, China.—The Kiangnan Dockyard plans the construction of another dockyard on the grounds in front of the naval wireless telegraph station.

Shipbuilding Activities, Hongkong, China.—Hongkong shipbuilders are reported to have under construction at the present time 44,759 tons of ships in three establishments alone, although there is a general depression in shipyards in other parts of the Far East. Four oil tankers of 5,600 tons each for the Anglo-Saxon Petroleum Company and one steamer for Jardin Matheson & Company are being built at the Hongkong & Whampoa Dock Company, Kowloon.

Port Project, Whampoa, China.—Negotiations are being carried on between a group of Chinese capitalists from the Straits Settlements and the Canton authorities to charter and open Whampoa as a commercial port. Extensive plans have been presented for the construction of a harbor capable of accommodating ocean going vessels.

Winter Cruises Arranged, England.—A series of winter cruises have been arranged by the White Star Line to the West Indies next January, February and March, the steamer Megantic to be put on this route. Two special trips from New York through the Mediterranean with the liner Arabic will be arranged for next January and February.

Steamer Launched, Amsterdam, Holland.—The 14,400 ton steel screw steamer Tjikarang, built to the order of the Java-China-Japan Line, was recently launched from the Amsterdam yard of the Netherlands Shipbuilding Company.

New Fleet of Steamers Nearly Ready, Hamburg, Ger.—It is expected that by the end of the present year twelve new steamers will have been completed at Hamburg for the East African service of the Woermann Line, the German East African Line, the Hamburg American Line, and the Hamburg, Bremen, Africa Line. The turbine steamers Wangoni, Usukuma and Usaramo, each of 7,800 gross tons, will be completed and ready for sailing the latter part of November, and will ply in the passenger service to South and East Africa.

Hamburg-Panama Service, Germany.—A new monthly service between Hamburg and Panama will be inaugurated with the sailing on November 15 of the Antiocha, followed by the Amassia, Andalia and Eupatoria. The ships range from 5,000 to 6,000 tons each. The vessels will also stop at the ports of Venezuela, Columbia, and through the Panama Canal to the Pacific ports of Central America and Mexico.

New Harbor, Shantung, China.—A new company is reported to have been organized for the purpose of opening and developing the port of Tsingingchow, and it is said that the Shantung provincial authorities as well as various ministries in Peking are ready to support the undertaking. The company has already collected $3,000,000 for this project, and proposes that the Government should furnish the remaining two hundred thousand dollars necessary for the carrying out of the work.

BUSINESS NOTES

The Quigley Furnace Specialties Company, Inc., 26 Cortlandt Street, New York, announces the acquisition of their pulverized fuel department by The Hardinge Company, 120 Broadway, New York. This department having been taken over practically intact, the Hardinge Company states that there will be no change in the method of conducting the business at their offices, and with their experience and manufacturing facilities will be enabled, with their present equipment and augmented staff to further extend the activities of the Quigley Pulverized Fuel System. The rapid growth of the Quigley Company's refractory specialties business (high temperature cement and insulation) has made it advisable for the company to devote their entire attention to this branch of work, which will be continued as heretofore.

TRADE PUBLICATIONS

Weld Pipe.—The characteristics and uses of hammer weld pipe, a new product of the National Tube Company, Pittsburgh, Pa., are given in a recent bulletin published by this company. The pipe is made by bending a steel plate into tubular form with the edges overlapping and then welding the overlapped edges after they have been heated, by hammer forging them on an anvil block supported on a horn inside the pipe. The manufacture is taken up in detail and applications of the pipe products are described and illustrated.

Fluid Compressed Products.—The growth and the development of the Sandusky Foundry & Machine Company, Sandusky, Ohio, producers of fluid compressed products in bronze, iron, and special alloys are given in this booklet. These products are used in pulp mills, chemical plants, hydraulic equipment, ship construction, pneumatic tubes and for various other purposes. Shop equipment required for the machining and working of tubular products is described in detail. Periscope tubes for submarines and tubes for propeller shaft sleeves are among the highly specialized products of the company intended for ship work.

Boiler Performance.—A folder giving the result of an official test conducted by George H. Perkins, consulting engineer of Boston, on a 950 horsepower Heine watertube boiler has been sent out by the Heine Boiler Company, St. Louis, Mo. Although this boiler was rated by the builders at 950 horsepower, it actually developed 2,858 horsepower in the test giving a load rating of 300 percent.

Don't Let It Happen to You.—This book gives the story of a business venture that might have been profitable only inadequate equipment caused a loss on certain contracts rather than gains that had been expected. The Williams Tool Corporation, Erie, Pa., uses this story to introduce the proper principles, machinery and dies which should be used for pipe threading, and the necessity of always maintaining an adequate supply of spare dies and machine parts. The book is actually a complete treatise on pipe threading practice and, as stated by the company, was written for the man who owns or operates a power pipe machine, and represents an earnest endeavor to educate all operators on power pipe machines to produce better threads while at the same time increasing their output.

Pumping Machinery.—A bound set of ten new bulletins showing equipment made by the Warren Steam Pump Company, Warren, Mass., describe vacuum pumps, horizontal duplex piston pumps, vertical single piston pumps, duplex plunger pumps, and other types. Special attention is called to bulletin No. 105, which contains useful information in the form of tables for designing and operating engineers. Bulletin No. 106 illustrates and describes the patented Warren "Eclipse" valve motion with which Warren single pumps are fitted. Positiveness of operation, economy of steam consumption and increased overall efficiency are claimed for this valve gear, which is installed on all reciprocating pumps on the battleships *Oklahoma* and *Idaho*, as well as on several of the ships of the present naval construction program.

Condensing Equipment.—A complete set of auxiliary equipment necessary for the operation of a modern steam power plant has been described in detail by the C. H. Wheeler Manufacturing Company, Philadelphia, Pa., in a book issued by this company. The economy of high vacuum and the thermodynamics of condensers in general are discussed in the first chapters of the book, while other chapters are devoted to details of jet, surface and barometric condensers, vacuum pumps, centrifugal and direct acting pumps, feed water heaters and the like. A special chapter outlines the difference between marine and stationary practice and the special types of equipment developed for marine service in which the requirements are more rigid than in land installations.

Cutting Costs.—Power and conveyor belting made by R. D. Skinner & Company, Inc., is the subject of a booklet recently sent out by the company. "Lion's Paw" belting is interwoven from cotton and coated by the Buckner patent process, which eliminates the necessity of surface treatment. Comparisons are made between the service obtained with this and other type fabricated rubber and leather belts, using the results of a series of efficiency tests on which to base these comparisons.

DeLaval Review.—For the purpose of setting forth the development of centrifugal machinery the DeLaval Separator Company, New York, has begun the publication of a monthly bulletin which is in the form of a news sheet. The first issue of the "Review" contained articles on the application of DeLaval transformer oil purifiers and multiple clarifiers to various industrial uses.

MARINE SOCIETIES

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Scrapping War Vessels Means That New Passenger Ships Are Imperative

WE are in full accord with the principle of the limitation of armaments and the cessation of the mad race for naval supremacy in "capital ships" which in the end can only mean financial ruin for the nations involved. But as great sea battles were fought in the days of ancient Rome with wooden vessels propelled by oars so could terrible conflicts be waged today with the giant ocean liners hastily equipped with aerial, chemical and submarine instruments of warfare too numerous to mention.

America must not forget that the importance of England's and Japan's great fleets of ocean liners will increase in far greater than direct proportion to the number of warships scrapped. We must start at once to construct a fleet of our own passenger ships, not only because they are sorely needed for commercial reasons but because the fast ocean greyhounds of foreign countries will have become the "capital ships" before the ten year naval holiday is over.

These liners are no more vulnerable to submarines than the battleships built prior to our 1916 program which we propose to scrap. On the contrary, and on account of their great length, they are now so constructed that four adjacent holds must be flooded to sink them. They can be convoyed by destroyers and auxiliaries to meet such of these vessels as we retain and they can carry light fast æroplanes equipped with machine guns which are more than a match for the heavy and comparatively slow bombing planes that would be capable of destroying them. In other words, the crux of the science of warfare is the ability to take and hold a position, and when the naval ships are gone, the giant liners will be the only vessels capable of carrying sufficient forces and supplies to do this.

And as our merchant marine, equipped as privateers, sank 2,000 British merchant vessels in the war of 1812 so could these foreign liners capture every vessel that we sent out. Right now, for example, there are ten Japanese and British steamship companies competing against one American company for the trans-Pacific freight and passenger traffic of Puget Sound. What else than 10 to 1 would be the ratio of the foreign naval strength to ours in that part of the world, if the navy is scrapped?

Why did the British Government loan the Cunard company sufficient money to build the *Mauretania* and the *Lusitania* and then provide a subvention sufficient to pay the interest and amortize the loan? Was it not because these vessels could be used for naval purposes even with a large navy in existence? Then how much more important will this type of ship be when there are no modern battleships?

But outside of protection, we need fast mail and passenger steamers for all our principal seaports on both the Atlantic and Pacific coast. We need over a hundred of them to balance our fleet and if we had them on regular lines they would create business for the freighters that are now tied up. Everyone knows that freight rates are scraping bottom but passenger fares this summer were higher than ever. Why? Because there is a deficiency rather than a surplus of passenger ships.

The time has now arrived when Congress can no longer evade this question. Although the Jones Law provides for the indirect aid that is necessary for the successful operation of our ships, we have reason to believe that the President is about to ask Congress to substitute direct subsidies in place of discriminating duties. Let us take a small fraction of the money that we would spend on naval vessels and put our merchant marine on its feet. In no other way can the United States, holding as it does the unique position of having no axe to grind, and no territory that it desires to acquire, retain the power to exert a proper amount of influence to prevent future conflicts. We should not only replace

the battleships that we scrap—ton for ton—with ocean liners but we should see to it that there are enough American ships suitable to carry the outgoing mail from all the principal sea ports of the United States.

Shipping Subventions

"IF we are to develop a successful merchant marine, we have got to pay for it one way or another." So spoke Mr. Holden A. Evans, then president of the Baltimore Dry Docks and Repair Company, at a banquet given by the National Marine League at the Hotel Commodore in the spring of the year 1919.

Mr. E. N. Hurley, who at that time was chairman of the Shipping Board, had just outlined his plan for the development of our shipping, and other speakers, influenced no doubt by America's remarkable achievements in manufacturing and other industries, had preached the "blue sky" doctrine that American ability and organization would assure the success of our merchant marine, when Mr. Evans, the only speaker in that optimistic gathering who had the foresight and courage to express his convictions, explained the shipping problems of this country in plain words which today are apparent and self-evident.

In some way or another the cost of operation and construction of American ships as compared with the corresponding prices paid by other nations must be compensated for or we can never become a maritime nation. It is unreasonable to expect that the labor that goes into the construction of a ship and its equipment which is subject to the high cost of living in this country will accept a foreign standard of wages. And this is equally true in operation, if we wish to man our vessels with American seamen.

Shipping and shipbuilding must rise or fall together, for successful operation requires the ability and knowledge to construct the most efficient, the most economical and the most modern type of ship and machinery for the particular trade or route upon which the vessel is to run. "There is not a surplus of useful ships," said President Franklin of the International Mercantile Marine Company last month. Our fleet is not balanced; if it were, we could place in commission a number of vessels that are now tied up. A proper subsidy is required for the operation of American vessels and this subvention would automatically place a premium on ships constructed in American yards.

It is all very well to talk about our ingenuity, mass production and the driving force of American organization, but a ship is not a typewriter or an automobile; it more nearly resembles a building in which the individual members must be erected and connected part by part. And, further, ask Joe Powell or Homer Ferguson if the majority of our best shipbuilding mechanics today did not learn their business in Great Britain?

Our shipping problem today has been complicated by the Conference on the Limitation of Armaments. It is understood that the President believes that the modification of treaties required for the enforcement of the discriminatory features of the Jones Act and the passage of the Borah Bill, exempting our coastwise ships from the payment of Panama Canal tools, would endanger the success of the Conference. As the President alone has the power to carry out the notification necessary for the modification of treaties we must now fight for a direct subsidy. We do not want a subsidy that will permit the operation of inefficient vessels. We want a subsidy only sufficient to induce capital to operate the best ships of our fleet and to construct the ships that are needed in American shipyards.

How much such a subvention would be, taking into account present costs, has not to our knowledge been determined. For a rough estimate between $30,000,000 and $50,000,000 per annum invested in subventions would save this country many times that amount in ocean freights.

Pioneer Purchasers

THE question of whether or not the original purchasers of Shipping Board vessels who paid $200 a ton for their ships shall be compelled to complete their payments and abide by their contracts involves a great deal more than a Santa Claus arrangement on the part of the Government to release them from a bad bargain.

Mr. R. H. M. Robinson, acting president of the United American Lines, stated very concisely at a recent hearing before the Shipping Board why it was to the interest of the Government to make such a readjustment in prices. He said in part:

"It should require little argument to show that any policy likely to result in the ruin of American companies who have already purchased ships from their Government (and that is what a strict enforcement of existing contracts will mean) would be almost totally destructive of the possibility of further investment of private capital in shipping.

"If the enthusiasm and initiative of the present private operators are crushed, if their attempt to assist the nation in disposing of its ships and in building up carrying trades for its commodities is rewarded only by ruinous losses, they will not be able to continue in business and another generation may pass before private capital can again be enticed to enter the shipping field and without private capital interested private ownership is impossible, and an American merchant marine becomes an abstract idea only."

In other words America has very few experienced ship operators and it cannot afford, in view of the fact that it demanded outrageous prices for its ships, based on an artificial situation, and then failed to afford the constructive help promised, to risk putting these men out of business when there are no others to take their places.

The plan of straightening out the difficulty which was also presented by Mr. Robinson would involve the fixing of a price for these ships approximating their present market value, a charter hire from the time of the purchase varying with the course of the market and the crediting of the sums paid in to the charter hire for the period of possession of the vessels and to payments on the revised purchase price.

The merit of this plan lies in the fact that adjustments could be made in negotiable certificates of credit which would be acceptable for further tonnage. As it is extremely doubtful if the Government can sell all of its 1,440 ships, it would appear that the Shipping Board has everything to gain and nothing to lose by recommending this plan to Congress.

Our Chance to Secure the Blue Ribbon of the Atlantic

Battle Cruisers Can Be Converted into 25-Knot Passenger Liners —Would Carry 3,500 Passengers and 2,500 Tons of Cargo

THE offer made by the United States representatives at the "Limitation of Armament" conference to scrap the twelve great capital ships now under construction for the Navy Department has naturally excited the most lively and widespread interest in shipbuilding and ship operating circles. This is due partly to the effect of such action upon the future power of our Navy, partly to the effect, direct and indirect, upon the large number of industrial establishments concerned and partly to disappointment that the solution of the many important engineering problems involved must be, at least temporarily and perhaps indefinitely, postponed.

The six battle cruisers, although not as far advanced as the battleships, are probably of more general interest than the latter because both of the novelty of the type in our Navy and of the enormous power and high speed contemplated. These ships were each intended to have almost twice the propulsive horsepower fitted in any other vessel, merchant or naval, now in commission with the exception of that installed in H. M. S. *Hood*. The speed contemplated, viz., 33¼ knots, is about a knot greater than that attained by the latter vessel. According to the Navy Department* the degree of completion of these vessels as of September 30, 1921, varied from 2.7 percent in the case of the *Ranger*, building at the works of the Newport News Shipbuilding and Dry Dock Company, to 28.4 percent for the *Saratoga*, building at the works of the New York Shipbuilding Corporation. The keels of all six have been laid,** in several cases the lower part of the hull structure is well advanced and machinery is probably fabricated in the shops or on order.

Destruction of These Vessels Unthinkable

The scrapping, when the term implies the wilful destruction of the fabricated structure or material so far as its value for all marine uses is concerned, of these vessels is unthinkable in this day when the conservation of both money and human effort is the rule, provided, of course, a proper use can be found for it. In the case of the vessels farthest advanced the cutting up of the hull structure, clearing the ways and the removal of the scrap, together with the compensation to the contractors for the cancellation of contracts, might easily run into millions. When to this is added the loss due to scrapping propelling machinery, armor plate and guns (these two latter essentially military) the cost of scrapping as defined above becomes staggering.

In an endeavor to find a use to which the structure and machinery already under way may reasonably be put and in which the energies of the organizations already interested may perhaps be enlisted, the possibility of the completion of some or all of these ships as fast passenger liners at once suggests itself. Let us examine some of the characteristics which were contemplated in the design of these battle cruisers in an effort to discover the degree of their adaptability for this purpose. Reference has already been made to the enormous power of their propelling machinery and to their great designed speed. In order to obtain the best possible results from the machinery installed, the form of underbody has doubtless been the subject of exhaustive experiments in the experimental model basin at the Washington Navy Yard. It is believed fair to assume that for the purpose intended a practically ideal form has been secured. At a speed of 33¼ knots, the length (850 feet), as published, gives a value of $V/\sqrt{L} = 1.14$. The underbody coefficients suitable for this value of the speed length ratio and suitable also in large, long vessels for values of speed length ratio as low as 1.00 to 0.95 and their use for values as low as 0.85 would still be favorable to speed and fuel economy. This latter value, for a vessel of this length, would correspond to a speed of just under 25 knots, probably equal or superior to the highest sea speed of the best Atlantic passenger liners of today. Hence, from the standpoints of speed and fuel economy, the form of underbody of these battle cruisers is probably well suited to the speeds of the North Atlantic passenger service.

27 Knots Obtainable with One-Half of Power Plant

For the carriage of passengers the large machinery plant intended for the battle cruisers is not only unnecessary but, if used, would involve ruinous fuel consumption. A few figures based upon Taylor's data for powering ships indicate that a maximum speed of about 27 knots for an 850-foot ship of the Atlantic liner type having about 45,000 to 50,000 tons displacement could probably be obtained with a power plant half the size of that intended for the battle cruisers. Such an installation could easily maintain a sea speed of 24, 25 or even 26 knots. It ought to be entirely practicable to install comfortably such a plant in any of the hulls even though some rearrangement of bulkheads were required.

The vessels of this class were practically redesigned in order to embody, so far as possible, the lessons of the recent war. Among the most important of these lessons, according to expert opinion both in this country and abroad, is the necessity of close subdivision. A fair assumption seems to be that these vessels are strictly up to date in this respect. While it would obviously be contrary to the spirit of the proposed naval holiday to fit protective deck plating, armor, or turret foundations in the hull of a merchant vessel, it would seem entirely in accord with the latest ideas to safeguard the lives of passengers, while at sea, in every practicable manner and close subdivision of hull structure would, therefore, be of great value in a passenger carrying vessel.

Another point in favor of a hull constructed on the principles referred to in the preceding paragraph is the availability of the numerous small compartments for the satisfactory stowage of fuel oil, a large amount of which would be required to drive a vessel at the high speeds contemplated between this country and Europe.

Stability Sufficient for Additional Deck

The extreme beam of the battle cruisers is given in the Ship's Data Book, previously mentioned, as 105.4 feet, somewhat greater than that of any of the present day liners. If it were practicable to adopt this figure as the beam of the passenger liner to be developed, ample transverse inertia of water plane would probably be secured to make possible the piling up of the number of decks necessary for passenger accommodations and for adequate depth of strength girder. In fact, it appears probable that an additional deck could be carried as compared with the number carried by the other vessels of the liner type now in service.

In the absence of definite information as to the displacements of the battle cruisers at deep drafts such as 35 to 38 feet and the principal weights and tank capacities contemplated in the design, it is not possible to fix a deep load displacement but it is considered that this would not be far

*Figures published in Marine Engineering and Shipping Age for November, 1921.

**See Ship's Data Book, July 1, 1921, published by the Navy Department.

from 50,000 tons. Such a displacement should be sufficient for the required amount of fuel oil, stores, passengers, etc., and it would probably provide for an amount of cargo comparable with that carried by other large, fast liners. If the relative lighter weight of naval machinery for the power developed, when compared with that of merchant ship machinery, be considered together with the smaller space occupied it would seem likely that space and weight for a relatively large amount of cargo could be provided. Inasmuch, however, as such spaces would probably be located amidships in the vessel's hold in compartments intended originally for boilers or machinery, access for the satisfactory handling of cargo might be difficult.

Deviation from General Methods of Design Unnecessary

In the foregoing it has been assumed that no difficulty would be experienced in designing suitable upper works for and in constructing them upon the battle cruiser structure now in place. An examination of the plans of several of the largest passenger liners now in service shows that the upper portion of the ship's girder is formed entirely of the vessel's shell and deck stringer plating. There is an utter absence of robust longitudinal bulkheads. This is, of course, largely due to the desire to secure space for passenger accommodations as free as possible from structural members. Such a design necessitates the fitting of very heavy topside plating. Following this general method it would appear entirely practicable to complete the hulls already begun as passenger liners.

The suitability of underbody form, the adaptability of part of the machinery installation, the value of the close subdivision for purposes of safety and for oil stowage, the ample beam, the additional stowage space gained because of the compact naval type of machinery, and the practicability of the development of a suitable hull structure have been touched upon in greater or less detail. There follows a table which emphasizes further by comparison with the finest vessels of the type now in commission the suitability of the suggested ship for the service in view.

It will be noted that the method followed in the treatment of the subject has dealt only with the engineering problem presented. The satisfactory solution of this problem alone by no means warrants the advocacy of the conversion suggested. The sanction of the armament limitations conference would be necessary in the first place. It would seem that there could be no legitimate objection to this method of utilizing the material and labor represented by these hulls and machinery plants when it is realized that as passenger vessels they would lack the turret foundations (to say nothing of the turrets and guns themselves), the horizontal protective plating and the side belt armor and conning tower and tube, as compared with the battle cruisers as designed. They would, moreover, be about 6 knots slower than the latter vessels and it would probably be impossible in an emergency to install additional machinery in the hold spaces available sufficient to attain the designed battle cruiser speed. An attempt to effect a conversion from passenger liner to battle cruiser in war time would probably be impracticable on account of the magnitude of the changes involved.

Cost of Conversion

Other things being favorable, the financial aspect of the subject remains for consideration. The terms upon which the hulls and machinery plants could be acquired from the Navy Department, the cost of their completion as passenger liners, and the possibility of successfully operating vessels of such size and speed under our maritime laws and in competition with the established and subsidized lines of foreign nations are among the considerations having a vital bearing upon the subject. Investigation would probably develop the fact that only through important governmental concessions could private enterprise complete and operate such ships. Perhaps nothing short of some form of governmental operation would suffice at the present time. In any event, however, the possibility of replacement ton for ton of every war vessel scrapped by efficient, up to date, merchant shipping in order to meet the demands of American business and convenience in the coming days is a subject demanding the most painstaking and enthusiastic study. Only through such study carried out with a determination to achieve tangible results can we hope to attain and retain a position of influence in international affairs at all commensurate with our national resources and opportunities.

Comparison of Principal Characteristics of Largest Ocean Liners With Battle Cruisers

Name	French Line	Cunard	Cunard	White Star	Battle Cruisers Completed as
Line	Paris	Mauretania	Aquitania	Majestic	passenger liners
Length, B. P.	735′	760′	868′-8½″	915′-9″	850″
Beam	85′-5″	87′-6″	97′	100′	105′-5″
Draft	31′ 1¼″	36′ 2½″	31′ 3″	38.5	assumed 35
Displacement	36,695	41,590	51,700	63,800	50,000
Speed Length Ratio	0.848	0.94	0.814	0.86	0.856
Block coefficient	0.658	0.602	0.609	0.632	0.558
Disp'l. Length Coefficient	92.2	94.6	79.2	83.0	81.5
Type of machinery	Turbine	Turbine	Turbine	Turbine	Turbine elec. red. gear
Type of boilers—fuel	Scotch D. E. oil	converting to oil	oil	watertube oil	watertube oil
Max. shaft horsepower	46,000	68,000	60,000	62,000	90,000
Max. speed	23	26	24	26	27
Sustained sea speed	20	24.5	22-23	23-23.5	*25
Number 1st class passengers	563	560	618	1,000	.....
Number 2nd class passengers	468	475	614	700	.....
Number 3rd class passengers	2,210	1,300	1,998	2,400	.....
Total number of passengers	3,241	2,335	3,230	4,100	Probably 3,200-3,500
Cargo capacity in tons of 100 cubic feet	**1,200	**1,200	**1,200	.....	Probably at least 2,500

*This figure tentative—subject to investigation as to service requirements.
**Rough estimate only.

How Can American Ships Compete Successfully With Foreign Ships?

By Winthrop L. Marvin*

How can American ships compete successfully with foreign ships? It is a far-reaching question that is stated in these words, a question that goes right to the root of the life of our present-day merchant marine. For unless American ships can compete successfully with the ships of foreign nations, which still manage to dominate our own overseas carrying, there can be no future for ocean shipbuilding and navigation under the American flag. Believing that the future livelihood and success of thousands of energetic and ambitious Americans hang upon a right solution of the problem of the ship in service, the author presented his views on the subject in the following paper at the annual meeting of the Society of Naval Architects and Marine Engineers held in New York last month.

THREE main causes well known to men of our maritime industry were responsible for the inability of successful competition under the American flag with foreign ocean shipping previous to the great war.

For more than a hundred years the privilege of wearing American colors had as a general policy been reserved to ships of American construction. Coupled with this reservation, in the earlier years of our national life, was a vigorous national policy of encouragement to American ships—the discriminating duty policy, so called—which absolutely guaranteed to these ships a strong preference in employment. Under this policy, not completely abandoned until 1850 against our chief competitor, Great Britain, the requirement that American ships must be built solely in American yards was by no means an actual handicap. The building of wooden-hulled sail ships for a hundred and fifty years before the founding of our Federal Government had been a firmly established and successful industry in North America. Materials were abundant and relatively cheap, and the skill of our builders was unsurpassed—indeed unequalled. No American merchants of that era desired to purchase or use foreign-built ships, for there was generally no advantage in securing vessels from abroad.

While wooden sail-ships were carrying the commerce of the world, this requirement that vessels of the United States should be American built was a just and prudent policy for the republic. This policy was not substantially weakened or abandoned until the Panama Canal Act of August 24, 1912, which for the first time in a general measure permitted the registry of foreign-built vessels for the purpose of engaging in the overseas but not in the coastwise trade.

Cause of Decline of American Shipbuilding

Because of the absolute lack, from 1860 onward, of any comprehensive encouragement for the employment of American vessels in other than our coastwise commerce, there was only scant, precarious demand for the construction of such vessels, and American ocean shipbuilding became a weakened industry. I have long been convinced that in past discussion of the decline of the American overseas marine altogether too much emphasis has been placed upon the change from sail to steam and from wood to iron and then to steel. It is true that, in the period from 1840 to 1860, the British iron industry was greater than our own. British machine shops and steam shipyards were mightily encouraged and strengthened by the generous British policy of mail shipping subsidies, initiated in 1840 and maintained with vigor and persistence until competing American steam services were driven from the seas.

But American shipowners and builders were by no means so unmindful of the advantages of steam propulsion and iron hulls as some of the commentators upon the fate of our ocean shipping have contended. The iron propeller steamer *Bangor* was built on the Delaware in 1845, a thoroughly efficient vessel for that period. In the years between 1850 and 1861 good iron steamers were built on the Delaware, at New York and at Boston. Indeed, good American iron was found to be superior for shipyard purposes. The United States possessed admirable iron works and a substantial body of highly skilled mechanics, as was to be demonstrated later by the rapid and successful building of a fleet of monitors that proved a decisive factor in the Civil War. Not only monitors but broadside armorclads and iron cruisers were constructed in this country in the Civil War period, and a vast impetus was given to boiler and engine-making establishments at the Northern seaports by the swift creation of a new fleet of the six hundred war steamers that constituted in 1865 the most modern and formidable navy in the world.

Overseas Shipping Unprotected

All these facilities for the building of steam, iron, seagoing merchant ships could readily have been turned to the construction of a new merchant tonnage in 1865 and after, if there had been any positive aid and encouragement to the successful operation of these American ships after they were completed. But, though the dominant republican administrations of that period wrought a gigantic success in the protection and development of the manufacturing industries of the country, the overseas shipping trade of the United States was left wholly without any equivalent encouragement. What was more natural and inevitable, therefore, than that manufacturing should flourish and ocean shipping still further decline through those years when Great Britain, thanks to the depredations of Anglo-Confederate cruisers, had dealt a terrible blow to our sail tonnage and had possessed herself of that lion's share of our overseas carrying which she retained up to the outbreak of the World War.

Without protection to the operation of American ships, the continued protection to the building of such ships of course proved wholly ineffective. Though iron ship construction, particularly in the Delaware district, made respectable progress in the years following the Civil War, these new iron steamships were designed for the protected coastwise trade, except for a few large passenger and mail steamers for the Pacific Mail, four excellent transatlantic liners for the Philadelphia and Liverpool service of the old American Line, and other good but smaller steamers.

Under the sharply contrasting conditions wherein British yards were building in swift succession twenty iron steamers while our yards were building one—that is to say while

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British yards were steadily manufacturing ships and our yards were producing irregularly a slender tonnage—what was more natural than that we should be seriously handicapped by a wide difference in the relative costs of construction? When in 1904-05 the Congressional Merchant Marine Commission under President Roosevelt made a careful survey of shipbuilding prices in this country and in Europe, the commission was constrained to report that steel steamships of the passenger and cargo type were costing from 40 to 45 percent more on this side than on the other side of the Atlantic. Under the circumstances, with no aid or protection whatsoever for American shipowners or operators, it was hopeless to dream of employing any considerable numbers of American-built ships in overseas commerce.

The Contrast in American and British Capital Charges

How heavy was that handicap can be demonstrated by a comparison of the capital charges of a British-built ship produced at a price of $500,000 and an American-built ship produced at a price greater by 40 percent, or of $700,000:

	British ship $500,000	American ship $700,000
Interest, 5 percent	$25,000	$35,000
Insurance, 4 percent	20,000	28,000
Depreciation, 5 percent	25,000	35,000
	$70,000	$98,000

Here, without any allowance whatever for the higher American wage costs of operation, is a difference in the main capital or carrying charges of $28,000 a year, or in itself a fair rate of dividend upon the total cost of the British-built vessel. This factor alone would suffice to bar the American ship from competition.

Moreover, the wages and maintenance of the officers and men of the American steamer were at least 50 percent greater than the wages and maintenance of the officers and men of the British steamer—a factor important of itself though of far less consequence than the handicap due to the higher cost of building as outlined above. It is not at all strange that from the building of the *Ohio* and her sisters for the Philadelphia American Line in 1873 the Stars and Stripes flew above no new American-built steamers exclusively employed in transatlantic trade until the keels of the *St. Louis* and *St. Paul* were laid by the power of a special mail subsidy in 1894 and 1895. Between far higher costs of original construction and higher costs of crew wages and maintenance, rivalry with European ships, often state-aided as they were, was accepted by American shipowners as impossible.

Government Aid for Foreign Shipping

When the shrewd diplomacy of Europe from 1815 onward had succeeded in enmeshing our Government in treaties that gradually prevented us from encouraging our ships through the historic policy of discriminating customs duties and tonnage dues, our competitors overseas lost no time in launching out on a new and effective expedient of their own—mail and admiralty subsidies and subventions. The first sustained British transatlantic steam service was created in 1839 by the grant of a mail subsidy of $425,000 a year to what is now world famous as the Cunard Company of England. Other subsidies, even larger in amounts, called into being the Peninsular & Oriental Line to India, the Royal Mail Line to the West Indies and South America and other British concerns, until finally thirty national steamship services reached all quarters of the world. France quickly followed suit. Germany put the powers of state aid, though in other forms than subsidy, behind the North German Lloyd and the Hamburg American. Our own Congress, in a fitful way, beginning with 1847, granted liberal mail pay to especial new American ocean steam lines, the best remembered of which are the Collins Line to Europe and the Pacific Mail to the Isthmus of Panama and on the Pacific Ocean.

But while other nations were united in loyal zeal for the national interests, it happened, unfortunately for us, that this new and crucial steamship competition fell in a period that saw America rent by the sectional quarrels immediately preceding the Civil War. Southern statesmen, who at first had borne a full share in urging encouragement to our own national mail lines, turned against them when they saw how swiftly these new lines were upbuilding the sea power of the North. In the very crisis of the struggle between our American lines and their European competitors, a hostile Congress, dominated by sectional prejudice, struck down the American mail subventions and thereby destroyed every one of the American steamship services in the transatlantic trade.

At this time the American Collins Line, with the largest and swiftest ships, was receiving a subsidy of $858,000 a year, and the rival Cunard Line $856,871 for smaller and inferior steamers. Soon after the Collins Line was killed by the act of our national lawmakers the Cunard mail pay was reduced by Parliament, demonstrating clearly that it was an aggressive fighting subsidy and nothing else.

But the British and other European policies of generous aid to national shipping lines, and thereby to steamship building and navigation, continued steadily without a break. It is sometimes urged that these governmental aids were not applied to "tramp" steamers. Directly they were not until France and Italy began to subsidize their entire shipping forty years ago. But, as a matter of fact, in a broad, true sense, these European subventions and other assistances in those earlier years did quicken and strengthen the then new arts of iron steam shipbuilding and boiler and engine building in such a way that even the "tramp" steamers that came afterwards were indirectly the beneficiaries of the system. Moreover, the subsidized national mail lines pioneered and created commerce a part of which the "tramps" subsequently carried.

The Ocean Mail Act of 1891

Until the United States in the Ocean Mail Act of 1891 tardily renewed the subsidy system in America, the decline of our own shipping remained constant. This Ocean Mail Law, though sadly crippled by Western agricultural opposition in its passage through the House of Representatives, did set the American flag again afloat on the great route across the western ocean and did permanently strengthen our steamship communications with the West Indies, nearby South America and Australasia. Services subsidized under the ocean mail law owned almost all the steam tonnage we had in ocean commerce when the great World War broke upon us in midsummer of 1914.

Turning from this survey of the past to the new present, what do we discover? Is there no more hope for successful American competition with foreign shipping than there was before the late great war?

For one thing, America has now what before the war it did not have—a large, actual, seagoing merchant tonnage available for immediate employment in overseas carrying. It has the ships and it also has the managers, the operators, the officers and the men. It is now conveying about one-third of our imports and exports, or three times the proportion of before the war.

The nation has 8,000,000 gross tons of newly acquired merchant vessels on its hands, ships in which all the American people are stockholders. These stockholders are unitedly determined that our ships worth having shall not pass out from under the American flag. Any political clique or party that consented to haul down the flag would be committing instant suicide.

PRESENT OUTLOOK MORE FAVORABLE

So the general outlook of the present is immensely more favorable than that of before the war for the development of a great ocean shipping and shipbuilding industry. But the obstacles in the way are substantially the same obstacles —the higher cost of operation and perhaps of construction of American vessels, the fact that even now our foreign competitors are in possession of two-thirds of the field, and the further fact that these foreign competitors in some way or to some degree are all powerfully upheld by the active aid of their own governments.

It is not now possible to speak definitely and with authority as to the comparative cost of building ocean ships in America and in Europe. But it is true that shipowners who have made inquiry on the other side within recent months have found that British shipyard prices were lower than American prices by at least a margin due to the abnormal state of sterling exchange. On the other hand, the American yards could offer quicker completion and delivery, which in normal times is of itself a marked advantage. Altogether it will probably be found, when conditions in America and in Europe have again settled down, particularly with "tramp" cargo vessels, that foreign ship prices remain lower than our own, though by a narrower margin than before.

As to the costs of operation involved in at least the wages and the maintenance of the crews, Europe retains an undeniable advantage as contrasted with America. The La Follette Seamen's Law, whatever else it may have done, has conspicuously failed to equalize sea wage conditions around the world. Individual foreign seamen have quit foreign vessels in our ports and have reshipped on other vessels at the American wage scale. But this process, though not without significance, has not of itself brought foreign war scales, as a whole, up to American wage scales.

On May 1 last the pay of engineers, sailors, firemen and stewards on American merchant vessels, government owned and privately owned, was reduced by an average of about 15 percent. The ensuing strike was quickly and easily won by the Shipping Board and private shipping companies. On August 1, 1921, the pay of the deck officers of American merchant vessels was reduced about 15 percent, so far as mates were concerned. The pay of masters, with their greater responsibility, was reduced less, or not at all. Early in May a reduction in the wage scale of British officers and men became effective without a general strike. New present wage rates of American and British officers and men for cargo steamers of the same representative type compare as follows:

COMPARISON OF AMERICAN AND BRITISH MARINE WAGES FOR *CLASS C STEAMERS

American Wages effective from May 1, 1921, and British Wages Effective from May 6, 1921

Grade	American	British £	British £ at $4.86	British £ at $4.00
First officer	$195.00	26/10	$128.79	$106.00
Second officer	170.00	21/10	104.49	86.00
Third officer	150.00	17/10	85.05	70.00
Carpenter	85.00	14/10	70.47	58.00
Boatswain	80.00	13/10	65.61	54.00
Able seamen	72.50	11/–	53.46	44.00
Ordinary seamen	52.50	7/10	36.45	30.00
Chief engineer	285.00	35/10	172.53	142.00
First assistant engineer	195.00	26/10	128.79	106.00
Second assistant engineer	170.00	21/10	104.49	86.00
Third assistant engineer	150.00	17/10	85.05	70.00
Donkeyman	80.00	13/10	65.61	54.00
Oiler	80.00	13/–	63.18	52.00
Water tender	80.00	13/–	63.18	52.00
Fireman	75.00	12/10	60.75	50.00
Coal passer and wiper	65.00	12/–	58.32	48.00

*Class C, from 7,501 to 12,000 power tonnage—gross tonnage plus indicated horsepower.

Reductions in an equal or greater ratio have since become operative among officers and men of the Norwegian and Japanese merchant services, but the data for exact comparison with American schedules have not yet reached the United States. It can be said, however, that America is now paying wages far higher than those granted by any competing nations, and that the cost of food or maintenance is also markedly higher, so that in this respect there is no important change whatsoever from the economic conditions that prevailed before the great war. Sea pay, which rose during the war in Europe as well as in America, has since been somewhat reduced in Europe as well as in America, so that the difference between American ships and foreign ships in wage cost and operation remains substantially the same as it was before.

WAGE HANDICAP GREATER THAN EVER

In fact, allowing for abnormal conditions of international exchange, the wage handicap against American ships is greater than ever. Foreign steamers plying in American trade demand their freight or charter hire in American money, but buy their supplies as far as possible and pay the wages of their crews in their own depreciated currency. The result is astonishing. A case just reported to the American Steamship Owners' Association is that of a Norwegian steamer of a deadweight capacity of 11,000 tons. Her total cost of crew, including officers as well as men, per month, taking the kroner at 12.65 cents, is $1,613 a month, while the total cost of crew of a submarine boat type steamer, with a deadweight capacity of 5,350 tons, is $3,302 a month.

Of course the abnormal difference in cost of operation, due to the present state of international exchange, is temporary; it will not last forever. But for the time being it has the practical effect of a profound discouragement to American shipping and of an actual subsidy to foreign shipping which will have to be met in some thoroughly effective way, if American shipping is to live through the crucial ordeal of the three or four years to come.

Wages and maintenance together make up about 15 percent of the total operating costs of a modern freight steamer. The present cost of wages and maintenance to our British and Norwegian competitors, largely because of upset rates of exchange, is nearly or substantially one-half our own cost. This exceptional difference, of course, will tend to decrease as financial conditions are restored, but for the present this extra cost of wages and maintenance is a grave handicap to American shipping in a period of unprecedented intensity of competition. The difference in wages and maintenance is all the heavier a handicap on the new American merchant marine because America still lacks the well-coordinated mercantile and maritime organization all over the world which enables British shipowners to meet the competition of continental nations having wage rates still lower than the British scale. The effect of this close British co-operation in every country, in every trade and in every port, of British agents, merchants and bankers in enforcing preference for British ships, makes that shipping in effect one of the most thoroughly protected industries of which there is any record in commercial history.

SHIP AND SAIL IN AMERICAN VESSELS

All over the world British manufacturers and merchants and their representatives will be found demanding that British ships must secure all the cargoes which they can manage to control. There must be similar tenacious organization and cooperation of American manufacturers and merchants in the interest of their own country's ships and their own country's flag if our new merchant marine is to have the even chance to which it is honestly entitled.

Another important factor in the maritime situation, beyond the lower wage and maintenance cost of foreign ships and the disciplined activity of our competitors, is the generous direct or indirect national aid extended by all governments, particularly to their regular line steamship services.

Just before the great war the United States Commissioner of Navigation published an analysis of the subsidies, subventions and bounties then being paid to the steamship interests of the world's chief maritime nations. These sums aggregated about $46,000,000 a year, of which Great Britain's own share was approximately $10,000,000. While the British and the Germans at that time gave direct state aid only for mail, passenger and fast freight services, it was significant that other governments, notably France, Italy and Japan, were subsidizing virtually their entire merchant marines and even giving direct bounties to shipbuilding.

As rapidly as possible, these subsidies, subventions and bounties are now being re-established—they were not necessary during the continuance of the war. It is probable that when the total sums of these state expenditures are again recorded they will be found amounting to a great deal more than $46,000,000 a year, for the war itself most vividly emphasized to all governments and all peoples the tremendous value, indeed the imperative necessity, of a strong commercial shipping for defensive and commercial purposes.

What We Must Do

What the American people must, therefore, prepare to do to enable American merchant ships to compete successfully with the ships of foreign nations is: (1) To find the most practicable form of equalizing American sea wages and costs of maintenance with the wages and costs of maintenance of foreign ships, by a system of preferential duties or subsidies and subventions, or some other still more effective method, if that can be found; (2) of organizing American manufacturers, merchants and bankers into a league as disciplined and powerful as the similar British league, for example, for securing the carriage of a greater share of our imports and exports to American ships; (3) of offsetting foreign subsidies, subventions, bounties and like national assistance given to the ships of our competitors. In addition, if it is discovered that the first cost of American-built ships is greater than the first cost of foreign-built ships, there must be full compensation for this factor also. In other words, the American merchant marine must be made what it has not been for more than sixty years, a nationally protected industry, as for most of the life of this republic manufacturing and agriculture have been protected industries. These things must all be done, or the new American merchant fleet, which is even now being beaten off the ocean by its competitors, will inevitably again decline and disappear exactly as the old merchant marine was declining from 1855 onward.

Moreover, it is essential that the classification and survey of American merchant shipping in the years to come be controlled by interests 100 percent American. The success of the American Bureau of Shipping is absolutely essential to the prosperity and security of the new American merchant marine which must also find in American hands the resources for a major part of the underwriting of the ships themselves and of their cargoes. Only the other day British marine insurance companies were assisting the Liverpool conference lines to retain complete control of the Egyptian cotton trade by allowing British ships much lower insurance rates on cotton cargoes than were being granted to American ships. The protective value of classification, survey and insurance of our own is a point that cannot possibly be overestimated in any study of the future of the American merchant marine.

American shipowners must develop, as rapidly as possible, what their fathers possessed before them, a corps of the most efficient seagoing officers in the world, every one an American citizen, and the largest possible number of citizen seamen. The American people will never consent to protect and encourage American shipping as it must be protected and encouraged so long as any substantial proportion of that shipping is officered and manned by alien subjects of foreign countries, our rivals in trade and possible enemies in war. Who can justify a merchant marine as a naval reserve unless it is securely held in loyal hands, and not in the hands of those who in an hour of need might betray it to the enemy?

Financial Statement of Shipping Board

A STATEMENT of the assets and liabilities of the Shipping Board as given by Chairman Lasker in testimony at an executive session of the Senate committee on commerce and the House committee on merchant marine and fisheries has been made public. The statement is as of July 1 and does not include unexpended appropriations, the fleet, or contingent cases and admiralty claims. The statement shows total assets amounting to $307,000,000 and liabilities amounting to $115,000,000, so that if the various claims against the board should run as high as $200,000,000, as estimated, it would have the fleet left. The assets as of July 1 were as follows:

Assets	
Cash	$33,000,000
Accounts and notes receivable	33,954,000
Accounts receivable of managing agents	9,360,000
Operating supplies	10,850,000
Surplus materials for sale, inventory value	35,561,000
Land, structures and equipment for sale	42,229,000
Mortgages receivable and securities	10,865,000
Notes receivable from ship sales (unsecured)	16,375,000
Notes receivable from ship sales (secured by mortgages)	98,997,000
Real estate and equipment used in operation	3,967,000
Total	$307,400,000

Liabilities	
Accounts and vouchers payable, accounts payable of managing agents, accounts payable for charter hire and refunds of deposits and collections	$71,482,000
Mortgage bonds and mortgages payable (obligations assumed on acquisition of property)	2,109,000
Reserve against value shown in inventory of surplus materials and lands, structures and equipment	42,287,000
Total liabilities, exclusive of claims	$115,878,000

The statement is regarded as important as the first of the kind that has been made to indicate to the board its financial status.

Egyptian Cotton Controversy Settled

One of the outstanding developments of the month of November was the settlement of the Egyptian cotton dispute. The Liverpool lines conference has agreed to the allocation of 50 percent of the tonnage in both the direct and indirect trade of Egyptian cotton to American vessels. They had previously proposed to give 50 percent of the sailings in the direct trade to American vessels, but this would not necessarily have meant 50 percent of the cotton and until now they have positively refused to grant any portion of this cotton going by the way of the United Kingdom to American vessels.

Regular Commercial Schedules

Chairman Lasker has decided to maintain the schedules of Shipping Board steamers so that they will conform to the best foreign practice. This will place our vessels in a much stronger competitive position and enable them to give the merchants in this country greater facilities for doing business. It will also inspire greater confidence in the operation of government tonnage. This action will be of the greatest benefit to exporters throughout the country, and it is confidently expected that materially increased support of American flag ships will be immediately forthcoming.

Present Indications Regarding Ship Operation

By Robert E. Annin

The successful operation and management of ship property involve factors so complex and far reaching as to require a grasp of conditions, prospects and possible influences broader, perhaps, than is needed in any other purely commercial vocation. Either ownership or management contain speculative elements which cannot be evaded. Capital once put into tonnage is fixed. Its profitable employment depends, in large part, on factors altogether beyond human control.

IT is the consensus of trained opinion today that not in modern times have conditions, influences and uncertainties created so confusing and perplexing a situation as now prevails for either owners or managers. These conditions extend to the very roots of industry, the prosperity of which is, of course, the essential basis of a prosperous commerce.

In every commercial community the dominant questions are: how much further are the reactions of the war likely to go; and how soon may the hoped for, and longed for, improvement be expected to set in? Speculation on this subject extends from the broad fundamentals to the conditions and prospects in every trade (and the opinions expressed are almost as numerous as the individuals expressing them).

Even now, however, certain facts and tendencies are emerging rather clearly from a badly confused situation. Notably the uncertainty of trade policies on the part of the great trading nations is likely to discourage the initiation of permanent and far reaching plans involving heavy investment. Even England and the United States appear to be considering changes in national policies so long pursued, that they had come to be tacitly considered as permanent by the generality of observers.

Change in Position of Tramp Steamer

Another item, which from the owners' and operators' viewpoint seems fundamental, is a change in the position of the tramp steamer. Such ships have been the backbone of the oversea commerce of all the great maritime peoples—notably England and Scandinavia—and have on the whole proved to them highly profitable. But today it would appear that the best days of the occasional voyager have passed and the business of oversea transportation is likely to tend increasingly toward lines giving regular and established service over permanent routes. Of this tendency the indications seem not only unmistakable but they are rooted in the economic drift of modern business, large and small. They are as inevitable as (for example) the concentration of land transportation, over the quickest and most economical routes, by vehicles carrying the heaviest loads at the least per ton overhead and operating cost. They are in line with the universal modern tendency to attempt economy through the organization of large rather than small operating units.

To illustrate: in 1895 (26 years ago) the handiest type of tramp steamer for a typical steady trade was what was called the twelve- or fourteen-load ship. This meant that steamers carrying from 2,500 to 2,900 tons of weight cargo were more profitable for irregular trade than either a larger or a smaller unit. In those days a twenty-load tramp (say 4,200 tons cargo weight) was considered large, and one of twenty-four-load capacity rather exceptional.

From 1895 on, the average size of tramp steamers has increased steadily, until today a grain charter under twenty loads is exceptional, twenty-five loads is ordinary, while anything up to forty loads does not attract attention as unusual.

This trend at least is obvious. The world's tonnage has constantly progressed toward the larger individual unit. The chief causes are clearly twofold. First, the smaller ton-mile expense (both overhead and operating) of the larger ship; and second (resulting therefrom) the progressive enlargement of facilities throughout the competing ports of the maritime world. Contributary to these is the general tendency of land transportation to seek the cheapest terminals; and the struggle of rival ports to provide facilities adequate for the largest volume of both land and water traffic.

Trade Follows Economic Lines

That the latter proceeds along economic rather than national lines is not only the teaching of commercial history, but is also clearly indicated by current developments. For instance, it is of public knowledge that a scheme for deep-water traffic via lake and canal to and through a Canadian port, in competition with New York and Boston, is securing support in over a dozen states in the western section of the United States. And it is to be further noted that the same port (Montreal) during the season now passing nearly monopolized the outward grain traffic of the Atlantic coast of North America, until its facilities became insufficient for the traffic which sought to move through that terminal.

The abnormal demand springing from war causes now being a thing of the past, it seems evident that the limit of economical size for occasional cargo carriers has for the present been reached. Grain, a most vital business for the tramp, is a seasonal commodity; therefore owners cannot base their calculations on the assumption that their ships will always, or usually, be employed in that traffic. Hence the tramp of the present and (presumably) of the immediate future must endeavor to strike a mean size, which in operating economy shall not be too small for the needs of the grain trade, nor too large for the average shipper of other bulk cargoes—ore, lumber, sugar, coffee, general cargo, etc. Especially during the period of depression in international commerce, tramps will require the support of many different trades and specialized types will be difficult to handle. Even during the recent English coal strike, when there was an eager demand for spot tonnage, it was difficult to place tramps of over 7,000 tons cargo capacity and often impossible to secure charters for ships of 9,000 tons and up.

Advantages of Regular Lines

The limit of size for liners, on the other hand, is fixed by only two considerations—the facilities at terminal ports and the average volume of cargo to be moved. This, combined with more permanent, economical and efficient machinery for obtaining, loading, discharging and transshipping cargo, give to the regular lines an increasing advantage as trade becomes more highly organized. True, they have special and large expenses in the maintenance of a relatively costly organization, but this again is offset by other factors—greater regularity of employment, lower per ton expense of transportation and the good will of an established clientele. The last is an asset none too great at best in so highly competitive a business as export or import, and almost non-existent as relating to casuals.

Again, the large freight liners are able more efficiently to specialize for the carrying of perishable goods or other cargo

requiring special provision and hence paying relatively high rates. In such trade, of course, superior speed insures a preference. The combined freight and passenger liner is looming up as a "dual purpose" ship which may easily find profitable employment when the pure cargo carrier would starve to death. In this connection it is significant that some of the oldest and largest transatlantic lines are building fast passenger steamers with generous provision for cargo—a rather recent departure for some of them. As a present influence, the collapse of the Baltic and Black Sea business, always a most important field for tramp service, must be reckoned with. How long it may be before this trade comes back to anything approaching a normal demand is any man's guess. Until then, the tramp tonnage thus displaced must react on the whole situation.

All in all it appears that future developments in ocean transportation will be such that tramps will occupy a much less important place than heretofore. The tendency will be to push them into feeder service. Certain lines of bulk commodities will always require full cargo charters, owing to special conditions. But the heyday of the tramp appears to be over, barring, of course, fresh and unexpected developments which shall neutralize the influences which are now so much in evidence.

Motorships

Other, and even more vital, changes are perhaps impending. The steady progress of the internal combustion engine is a fact of great significance. The average steam engineer, with the conservatism of his kind, has been inclined to view this as an interesting but more than doubtful experiment, unlikely seriously to threaten the dominance of the steamship at least for many years. A few successful and comparatively short trials of any novelty do not warrant conclusions on which far reaching plans can be based. But the so-called motorship seems to have passed out of the experimental and into a highly practical stage of development. In other words the motorship, formerly a question chiefly for engineers, is entering upon a period where it becomes a large practical question for operators, and growing records of actual service are attracting increasing attention. Not only do many of such records measurably bear out the claims made for this type, but evidences of the conversion of experienced steamship owners multiply. Reports of remarkable achievements have been common for some years; but trial trips and short voyage records are not convincing in a matter where sustained performance, maintenance costs, replacements and the indications as to length of competitive life are of the essence of the problem.

One recent record of achievement, recently published, seems, however, worthy of special notice. The tanker *Narragansett,* built by Vickers at Barrow, and with a total deadweight capacity of 10,000 tons, is said to have accomplished in twelve months service an average speed of slightly over ten knots on slightly less than ten tons average daily fuel consumption, against an estimated consumption of 35 tons per day with oil burning steam machinery. After covering 60,000 miles in Atlantic service, her engine repairs are stated to have been trifling, while the performance of the ship in other respects was entirely satisfactory to her owners.

Of an American built ship of this type, it is reported by her operators that on the completion of six months continuous service (as yet uncompleted), she promises to show an *operating* profit of $100,000 as against an estimated net loss of $6,000 with coal burning steam machinery.

Comparisons Not Necessarily Conclusive

These comparisons are not necessarily conclusive but they are certainly of interest to the operating end of the business. Once established, any type of engine that can avoid from one-half to two-thirds of the ordinary fuel expense of competitors must push its way rapidly by the mere force of economic selection. How rapidly such an advantage might become a decisive factor may be judged from the recent strides made in the construction of oil burning steamers as against coal.

According to the last annual report of Lloyds Register, the afloat tonnage of the former in 1921 was nearly ten times that of 1914. Comparisons are stated as follows:

1914	Oil burning steamers.....	1,310,000 tons
1921	Oil burning steamers.....	12,800,000 tons

The same report states that of all the ships classed in the year ending June 30, last, no less than 58 percent were oil burners (not including older ships converted from coal to oil).

On the same date 50 motorships were reported under construction in the yards of the United Kingdom.

Under existing conditions the replacement of steam by internal combustion engines would be slow, even if the experimental stage on the latter were admittedly over. The inducements for new investment in the field of ocean transportation are at present meager and for some time to come are likely to remain so. The heavy additional expense of installation will be a deterrent; and for the near future at least the scarcity of engineers familiar with this type of engine.

But there is every prospect that, in the replacement of tonnage, the motorship will receive increasing consideration. Thus far the proportion of this type in operation has not been sufficient to be an influential factor in fixing the level of freights. But when and if such proportion increases, the influence on rates will necessarily increase also and the matter will become of vital import to owners and operators of every class of ocean carriers.

Such innovations may have an important effect on the question of bunkers. That cheap fuel is the most important physical factor in operating costs is axiomatic. If it were not, the ledgers of operators during the last six years would have proved it to demonstration.

Economy of Oil Fuel

Oil, as a fuel, has been rapidly displacing coal because the greater *per ton* production of power and the resultant increase of revenue producing capacity have more than offset the higher per ton cost. There are other factors, such as economy in loading, saving in wages, subsistence, etc., but the two items above named are the main factors. Clearly, therefore, the advantage of oil tends to disappear with any *relative* advance in price (as compared with coal) and with progressively declining freight rates. The latter of these factors is now much in evidence. The former may be impending. In fact the recent general advance in oil prices, while nearly every other commodity has declined, suggests that both influences are now to be reckoned with.

The demand for oil as a power producer is increasing by leaps and bounds in all directions. As a lubricant, at all capable of meeting an increasing demand, no efficient substitute for mineral oils is in sight. Therefore, if we assume a steady price for bunker coal, at or about present prices, and a continued advance in mineral oils, the point is not far off when the former will again become the cheaper fuel.

In this matter it is not necessary to guess how distant the "exhaustion" of the world's oil supply may be. For purposes of the present argument the only pertinent question is "How long can the superior efficiency of oil (all things considered) offset the higher per ton cost?" In view of the discouraging outlook as to freight rates, and present relative costs of the two fuels, this turning point may possibly, from an operator's standpoint, be very near. So far as concerns increased revenue, due to the release of cargo space and lift, this will be largely theoretical, as long as ships sail with partial cargoes one way and return in ballast.

Transferring Transport Service to Steamship Lines

By Waldon Fawcett

A point that has been forcefully brought out in the discussions on the Edmonds Bill is that not only has the Army Transport Service, as heretofore conducted, been withholding the support that might fittingly be furnished for the establishment of permanent steamship lines, but it has, all the while, been robbing the merchant marine of a share of its income from civilian passengers. The diversion is due, of course, to the abuse of the privilege whereby passengers are carried on Army transports for a nominal fee—formerly $1 per day, latterly $1.75 per day.

IF only the opposition of the War Department can be overcome, there will shortly be imparted a worth-while new stimulus to the development of the American merchant marine. This promising innovation contemplates the discontinuance of the Government transport service and its replacement by permanent steamship lines, operated under contract by private interests. The Navy Department, notoriously more progressive and farther-sighted than the War Department, is heartily in favor of the contemplated change. But the Army, with something of that selfish autocracy of which it cannot divest itself even in time of peace blocks the project, although it was long ago recommended by the ablest Secretary of War of the generation.

Impatient at the perversity of the Army officers who are loath to relinquish any of their perquisites, Congress proposes to take a hand. Pending in the House of Representatives is a bill (H. R. 5348), introduced by Congressman Edmonds, that would to this end amend sections 17 and 19 of the Merchant Marine Act of 1920. Extended hearings have recently been held upon this bill at which the sentiment in merchant marine circles was voiced by representative steamship owners. However, the Merchant Marine Committee of the House defers recommendation to the lower branch of the national legislature pending a report from the Shipping Board which is now investigating the proposition from the standpoint of the obligations that would be imposed upon this institution.

Basis for Permanent Steamship Lines

The new paragraph which the Edmonds bill would insert in the Merchant Marine Act would authorize the Shipping Board to, whenever possible, utilize the transport of the Army, Navy or Marine Corps as a basis for the establishing of permanent steamship lines. Where such opportunity presents the President is empowered to discontinue transport service by the Government and contract with the new service for a period not exceeding ten years. It is stipulated that no contract shall be made with any steamship company whose ownership is less than 75 percent American and it is also requisite that all the contracting companies' ships, owned directly or through subsidiaries, shall be registered or enrolled under the laws of the United States.

Coupled with the foregoing in the pending bill is a second section which, at casual glance, might appear to have no connection with the replacement of the transport service but which, as will hereafter appear, has definite contact with the main issue. This second stipulation of the Edmonds bill is to the effect that any contemplated extension of service by the Panama Steamship Company shall be submitted to the Shipping Board for approval and all extensions of service made by this company since in control of the Government shall be approved by the Shipping Board or discontinued and all freight rates established by this company shall be in agreement with rates established by the board for its operators and be subject to the approval of the board. A perusal of this second half of the bill will reveal, if the first part did not, why the Congressional committee awaits the comment of the Shipping Board before pressing the pending measure.

Constructive Possibilities

Representative George W. Edmonds of Pennsylvania, author of the bill that proposes to provide additional profitable employment for the American merchant marine, has strong faith in the constructive possibilities of the proposal. He feels that, by this means, the Government may without recourse to subsidies, or subvention or anything of that sort, utilize its normal and inevitable expenditures for transport service to build up steamship services that are needed and that might be expected to continue even though there was fluctuation in the volume of military or naval movement.

"My idea," said Congressman Edmonds, not long ago, "is to go to a steamship line or have a steamship line come to the Government and say: 'You are using one ship a month between San Francisco and Manila—with its ramifications up to Nagasaki or over to Shanghai or Tientsin—and we are willing to make a 10-year contract with you to do this service.' If such a contract were made then you have basically done something for the steamship company that they can count on as a positive income to utilize toward building up a service or a line between the two countries, the idea being to abandon the transport service of the Army and to contract with a steamship line to carry the men.

Not An Innovation

"This is not any new thing; it is not a new thing of mine. England has always done this in building up lines to her colonies and Japan is doing it today. I traveled on Japanese steamers over in the East and I found these contracts with the steamship companies and Japanese officers and privates traveling on those steamers. It is my idea that in this way we will build up a permanent establishment, because it will provide a steamship line with an income from the transport service and then the company will start to build that service up with other freight and other passengers. England is using such service to South Africa and in Australia and there is no reason why, in making contracts with steamship lines, you could not provide for the use of the steamers in time of war. If there is a man who would come to me and offer to do this service at the same price, and I know that I can accomplish the establishment of a steamship line between certain points, I can not for the life of me see why he should not be allowed to do so. This plan will not cost any more money—and the men in the Army know it as well as I do."

Army officers who have advised Congressmen with respect to the Edmonds bill have contented themselves with the objection that there is nothing in the plan that would lead them to believe that the service will be any better or that the service will be any cheaper than at present. They have missed entirely the constructive note that has been struck by the members who are pushing the bill, and have assumed that the dollars-and-cents aspect, in its immediate applica-

tion, is all that concerns the national legislature. Other than this the only argument advanced by the chief of the transport service of the United States Army to warrant continuance of the present system is that it builds up an Army personnel in time of peace that knows something of the routine of handling troops at ports of embarkation and also the methods of getting them on and off the ships.

Agrees with Policy of Jones Bill

Probably the most forceful presentation that has been made at Washington in behalf of the Edmonds bill was that of Mr. Winthrop L. Marvin who, as general manager of the American Steamship Owners' Association, spoke for the entire membership of that body comprising about seventy American companies operating and owning ocean steam shipping under the American flag to the aggregate of 3,000,000 gross tons. Mr. Marvin, in conference with the Merchant Marine Committee, made the point that Congress was virtually committed to the policy exemplified in the Edmonds bill because, by the Merchant Marine Act of 1920, the legislature, in effect, declared for an ultimate policy of private ownership and operation. If an end is to be put to all competition between Government-owned shipping and the fleet controlled by private capital and enterprise, supplementary policies such as that contemplated in the pending bill are actually essential.

There has been instanced at Washington the fact well known to every person at all conversant with the subject that the Army transports have been crowded at every trip with persons in no way connected with the Army and with the most distant relatives and most remote connections of Army officers. There was discussion in the Merchant Marine Committee, anent this abuse, of the junket of a ship load of school teachers to Porto Rico on the first transport built at Hog Island. And as an illustration of what has been going on there was cited the spectacle of the Philippine delegates to the Congress of the United States, collecting $30,000 in mileage and traveling back and forth across the Pacific on the Army transports.

On behalf of the steamship owners it has been pointed out to Congress that the ownership and operation of transport steamers by the United States Army and Navy were due, originally, to conditions which no longer exist. The Army transport service to the Philippines and Panama and the Navy transport service to Haiti, San Domingo, Samoa and Manila were all established prior to the World War when the merchant marine of the United States was far more limited in its resources than at present. The War Department and the Navy Department were virtually compelled to establish their own services because of the lack of adequate privately-owned shipping facilities. There is apparent reason to declare that it was never contemplated that these Government shipping services should be permanent.

Private Lines Can Handle Troops at Less Cost

Steamship operators have no intention of allowing Congress to remain in ignorance of the motives of Army officers in opposing the surrender of any of the existing transport service. It is recalled that as far back as 1902 Elihu Root, then serving as Secretary of War, made the significant statement: "I am satisfied that it is practicable for the private shipper to do ordinary business much cheaper than it is possible for the Government to do it under the limitations which rest upon Government action, and that they can afford to do the business for less than it costs the Government and still make a profit." And now, after two decades, we find the present director of ship movements of the United States Navy Department substantially concurring in this view and stating that the Navy Department prefers to use space in merchant shipping and does so whenever it can. Furthermore this naval authority has, within the year, stated to Congressmen that not only does the Navy feel that it should not operate vessels where they will compete with merchant vessels but that the Department realizes that it can not operate them as economically as cargo space can be obtained from well-established lines.

Caused Abandonment of Trans-Pacific Services

Stubborn, selfish insistence by Army authorities upon the operation of their foreign-built transports on the Pacific in the face of Mr. Root's recommendation and in defiance of the no less emphatic expression from a Congressional merchant marine commission appointed in 1905 upon the initiative of President Roosevelt was, according to evidence just placed before Congress, "a powerful contributing factor" to the final abandonment of American trans-Pacific services out of Puget Sound and San Francisco and the sale of the ships formerly in those services to foreigners. Thus, in the words of Manager Marvin, the War Department made victorious war not only upon the American merchant marine but likewise upon the auxiliary cruisers of the Navy Department.

It is being impressed upon Congress that the transfer to the American merchant marine of the financial support that now goes for naught in the operation of the transport service is no minor matter but a move for self-preservation that is imperative, if the American merchant marine is to survive on the Pacific. In no other way will United States mail, passenger and freight steamers have a chance to live against the subsidized, cheap-wage competition of the paralleling Japanese and British lines. Solemn warning is given that conditions in the Pacific just now are such that the breaking down of the American services and the driving off of the Shipping Board's commercial lines might prove a national calamity.

Pacific Coast Ships Only Partially Loaded

Speaking in behalf of the Pacific Mail Steamship Company, Mr. Robert H. Patchin at a recent session called the attention of the Merchant Marine Committee of the House of Representatives to the fact that at the present time all of the nine large passenger-carrying vessels operating in the trans-Pacific trade are sailing from the Pacific coast only partially loaded because of the operation of United States Army transports in direct competition with them. To the same end, the Pacific American Steamship Association has made the point that the present competition merely makes both Shipping Board and Army vessels unremunerative at public expense. The burden on the taxpayers of the country is, of course, particularly heavy in the case of the Army transports which, by reason of taking cargo in but one direction and maintaining separate terminals and operating forces, have a high overhead as compared with merchant vessels in regular trade.

A clue to what is in the Congressional mind was supplied when representatives of the Pacific lines, appearing at Washington, were asked by committeemen at the Capitol whether, if they were enabled to obtain the business now being handled via Army transports, the companies would purchase vessels from the Shipping Board to supply this service. When no assurances on that score were given by the shipping men, Congressmen inquired whether, if the transport business were thrown to them, the ship operators on the Pa-

cific, who have announced their ability to handle this traffic, would give up their present M O 4 contracts with the Shipping Board and, accepting instead bare boat charters, would operate vessels without guarantee of a percentage profit.

PANAMA STEAMSHIP COMPANY

The second section of the Edmonds bill, that designed to bring the policy of the Panama Steamship Company into harmony with Shipping Board policies, might appear at first glance simple in purpose and direct in method but in reality it has behind it a complex issue, to explore the controversial phases of which would require many pages of this journal. Alike to the other section of the bill, inspiration came from a seemingly trivial incident. The report that the United States Army contemplated an extension of its present transport service spurred the friends in Congress of the United States merchant marine to make effort to end once and for all the insidious competition. The reputed action of the Panama Steamship Company, in going out of its normal sphere of operations and underbidding Shipping Board vessels by $2 a ton for the movement of phosphate from Tampa, served to bring about the present deliberate effort to bring the Panama line within the jurisdiction of the Shipping Board in matters of freight rates and operating policies.

Testifying at length before the Merchant Marine Committee, Mr. Thomas H. Rossbottom, vice-president and secretary of the Panama Railroad Company, has acquainted Congress with all the circumstances and influences that induced the executives of the Panama Steamship Company to adopt the traffic policy and the rates which have been "under fire" in the shipping world. He declared in so many words that all the projects for the gradual extension of the services of the Panama Steamship Line, regarding which so much has been heard, are "dreams" of certain newspapers and two nautical journals. Nevertheless, members of the Merchant Marine Committee made clear their realization that on many a route in the Caribbean and in South and Central American waters there is room for only one line to operate profitably and that no private line can hope to compete with a line for which the Government furnishes the capital without interest or other charges.

Various expressions have been made to the Congressional committee of the position of the private interests operating in the West Indies and Latin-American waters, notably the recital of the position of the Clyde Steamship Company made a few days ago by C. H. C. Pearsall, general manager of the foreign services of the Clyde Company. Mr. Pearsall has detailed graphically the history of the entry of the Panama Line into Haiti and of its cut of 25 percent under the rates of the private line, thereby forcing that private line to carry the freight to the outports at a reduction of 25 percent, though that private line only participated in 40 percent of the possible volume. All the shipping men who have contributed to the discussions have declared that if United States trade in the West Indies is to be developed through the instrumentality of private lines there must not be Government competition.

Proposed Plans For Revision of the Navigation Laws

Adoption of Merchant Shipping Act of Great Britain Advocated— A Precedent Found in Action of Navy Thirty-Five Years Ago

By C. A. McAllister

THE problem of devising ways and means to assure the permanency of our merchant marine is still an acute one. Depression in the world's business is felt more in ocean shipping than in any other branch of industry. With most of our shipyards idle and with over two-thirds of our merchant fleet tied up, there is now ample time and opportunity to discuss ways and means to put the facilities for our sea commerce in order, so as to be ready for the revivification of ocean carrying when brighter times come, as come they must.

No matter what schemes may be advanced by interested parties to accomplish the desired permanency of operation, there is, and has been for many years, the underlying feeling among shipping people as well as with the public at large that our navigation and steamboat inspection laws are accountable for holding back our development on the seas. With such a universal belief, it is quite patent that something should be done to investigate the matter and furnish relief to our shipowners, if relief is really found to be necessary.

CONSIDERATION OF NAVIGATION LAWS NOT OVERLOOKED

It is generally supposed that the Government has been remiss in its duties, so far as this important subject is concerned. Such is not the fact, as when the bill creating the Shipping Board was passed back in 1916 it was made the duty of that body, among many other requirements, to investigate the navigation laws and to report to Congress what changes, if any, were necessary to remove any discriminations against American vessels. It is now a matter of history that shortly after the Shipping Board began to function we were plunged into the world war and all functions of the Shipping Board, other than those necessary to provide ships with which to help win the war, were, of necessity, sidetracked. However, in the fall of 1919, the Shipping Board took up that portion of the law requiring it to investigate our navigation laws and after due consideration decided that it would be better to have a committee of experts to report upon conditions as they were and report to the board such changes as it might deem advisable.

SHIPPING BOARD COMMITTEE APPOINTED

The committee was duly appointed and consisted of Mr. Franklin (chairman); Mr. Ferguson, of the Newport News Company; Mr. Kirlin, the Admiralty lawyer; Mr. Smith, president of the Ward Line; Mr. Furuseth, of the Seaman's Union; Mr. Brown, president of the Marine Engineers Association; Mr. Warden, then of the Standard Oil Company; Captain O'Donnel, of the Sprague Steamship Company; Mr. Alexander, of the Pacific Coast Steamship Company; Captain McGray, of the Neptune Association, and Mr. Delancy, of the Shipping Board. The writer was appointed as secretary of the committee.

During the winter of 1919-1920 this committee functioned as best it could during the period of inflated prosperity in all branches of industry which followed the world war. All of the members devoted as much of their time as their very important private business interests would permit. The committee was actuated by but one motive and that was to investigate matters as impartially as possible and to make

their recommendations for the very best interests of the American merchant marine. There was at all times, among all of the members, a sincere desire to do justice to every element interested in the subject.

Extensive Data Collected

At the time the meetings of the committee were commenced, the widest publicity was given to its objects and constructive suggestions were invited from all interested persons. Following this appeal many of the leading men in shipping and its allied industries presented their views to the committee for its consideration. These constituted the basis upon which the investigations and recommendations of the committee were made. It was impossible, naturally, for a committee composed of men of such large business interests to go into all the details of the subject, hence its reports and recommendations have been confined to items of major importance.

It is not within the province, and far from the desire of the writer, to divulge what these recommendations have been, as the committee holds that its relations with the Shipping Board are entirely of a confidential nature. It is, nevertheless, due the public to be advised that these recommendations will form the basis of re-codification and revision of all the laws relating to shipping, which the Shipping Board is having prepared by a special Admiralty counsel appointed by the board. It is understood that when this work is completed, the new code will be presented to the Congress for its consideration and action. Work of this kind is necessarily arduous and complicated, as it is absolutely essential that it be done thoroughly and accurately. The work of revision is now well advanced and should be presented to the present Congress.

Entirely disassociated from the membership of this committee and its reports, which were filed with the board over a year ago, the writer learns from various associations among shipping men that there has recently been a growing sentiment among people interested in our shipping activities to the effect that the surest and best way to place our merchant marine on an equal footing with our shipping rivals is for Congress to adopt for all our vessels in the foreign trade the Merchant Shipping Act of Great Britain. The men who favor this procedure have in no instance been those who can be called pro-British in thought or action; on the contrary, some of them I have talked to on the subject are the leaders in the demand for a strictly American merchant marine in every particular and have proved by their action that they are sincerely devoted to the upbuilding of our own shipping.

Merchant Shipping Act of Great Britain Advocated

They base this contention for the adoption of the Merchant Shipping Act on the fact that Great Britain is the premier maritime nation in the world and besides knowing the business thoroughly has by far the largest fleet of merchant vessels. The laws which have sufficed in the building up of this shipping supremacy must be such as to have given the British shipping all necessary protection, without in any way hindering its development. It is frequently claimed that, so far as governmental regulation is concerned, our ships are at a decided disadvantage when compared with British vessels. Very well, then, why not adopt the very laws which gave the advantage to British vessels over our own vessels? Our common law is based on the common law of England. Because they are British laws is no reason why they would not work just as well on our own statute books. Imitation is said to be the sincerest flattery and there seems to be no good reason advanced why we should not avail ourselves of this code of maritime laws, built up with years of successful experience in operating ships in the foreign trade, which we, as a nation, have not had for over fifty years.

Action of the Navy Establishes a Precedent

About thirty-five years ago we began to construct our so-called New Navy. For a period of over twenty-five years up to that time, naval construction in this country had been a lost art. Great Britain had been compelled then, as always, to keep her naval efforts up to the top notch. As a result she had far outstripped us in the efficiency of war vessels. The then head of our Navy Department, for a comparatively small sum, purchased from English firms complete detailed designs for an up-to-date battleship and several large cruisers. A great howl arose in many quarters in this country about the alleged unpatriotic act of purchasing plans abroad for our war vessels. The contention was that, despite our inexperience in warship construction, we could, unaided, produce designs to equal or better the British designs.

The writer was then connected with the Navy Department and worked on plans used in the construction of many of our new war vessels. The purchased plans were consulted by all and proved of the greatest value. By getting these plans we had secured the accrued experience of people who had been following that line of effort during a period of a quarter of a century, while we had done nothing. Our designers were not to blame because they had nothing to build during that period of inanition.

With the start obtained by thus adopting the experience of others, our naval designers soon became absolutely independent and now for many years the designs of our naval vessels, strictly American, have been sources of pride to our own people and of admiration of our rivals. To recognize that which is good and worthy of emulation in others is not unpatriotic by any stretch of the imagination; on the contrary, it is entirely logical, and an evidence of good common sense.

Revision of Navigation Laws a Parallel Case

The matter of navigation laws is, in the writer's opinion, almost a parallel to the naval construction incident herein quoted. During the long period in which we were somnolent in foreign shipping Great Britain has forged ahead. Now that we are striving again to take our place on the seas what is more logical than to adopt her best methods, to the end that, as we gain experience, we may equal or better her, insofar as getting and holding our just proportion of the sea-carrying trade of the world is concerned?

American ships should have every advantage and privilege given to the ships of other nations and as much more as we can give them. When the matter of revising our shipping laws reaches Congress, let us devoutly hope that they will carefully consider all phases of this situation and do what is best. If some code of laws, which regulate and protect the ships of our rivals, is found to be more advantageous than the code our vessels have been working under, then do not let us hesitate to adopt them, be they English, French, Scandinavian or Hottentot.

Foreign Trade Vital to Commercial Future of United States

That the commercial future of the United States depends upon a development of a permanent export market, and that the wartime foreign trade of this country was artificial and is being rapidly lost, were points brought out strikingly in an informal talk given at the United States Shipping Board to a body of newspaper representatives by R. T. Merrill, of the staff of Vice-President J. B. Smull, of the Emergency Fleet Corporation. His subject was but one of a number of studies which the board is having made of the basic facts affecting and underlying world trade conditions and especially the economic position of the United States.

Shipping Board Ready to Operate Under Jones Act

Chairman Lasker and Board Handling Shipping Policies, While J. W. Powell, Surrounded by Competent Shipping Men, Directs Operation

WHEN Charles Piez, former director general of the Emergency Fleet Corporation, called at the Shipping Board on November 15, he expressed the opinion that the Shipping Board had made remarkable progress and that Mr. Lasker had applied to the Shipping Board and Emergency Fleet Corporation a scheme of organization existing in many large industries. Mr. Piez declared that the board was now in a position to put into operation the excellent provisions of the Merchant Marine Act and that Mr. Lasker had, by appointing Joseph W. Powell president of the Emergency Fleet Corporation and surrounding him with competent ship operators, placed his house in order to do business.

According to Mr. Piez the principal trouble today is the vast reduction in tonnage of ocean freights which has caused a stagnant market for ships which will not improve until there is a resumption in foreign trade. He said, "constant criticism of the Shipping Board based in many cases on absolute ignorance of the conditions is fast destroying what little hope the American people have in the successful establishment of an American Merchant Marine."

Combination Cargo and Passenger Ships in Demand

Hearings were held before the Shipping Board on November 14 relating to the allocation of the "535" and "502" foot combination passenger and cargo steamers to operators on the Pacific Coast. Representatives of the ports, the interested steamship lines, the trans-continental railroads and the various civic organizations presented arguments in favor of their respective terminals.

The ports were requested to sponsor the steamship company or companies applying for allocations and the steamship companies were asked to submit a brief history of their lines, outlining their finances, connections and personnel.

A point brought out was that any service established by the board under the Merchant Marine Act must be adequate, regular and permanent. At the present time, it was stated, it takes a "535" type of passenger ship 70 days to make a round trip from San Francisco to the Orient. With three of these steamers in service a sailing can be made every three weeks and with five a two weeks schedule can be maintained.

Pacific Coast Requirements

The number and types of ships that were requested for allocation to Pacific steamship lines were as follows:

Five "535" combination passenger and cargo ships for Seattle.

Three "502" combination passenger and cargo ships for Portland.

Five "535" and two "502" foot combination passenger ships for San Francisco.

Three ex-German liners for tourist traffic between Los Angeles and Honolulu.

San Diego also requires passenger ships but has not stated the number.

Atlantic Coast Requirements

Frank C. Munson, president of the Munson Line, stated that he had a contract with the board, dated August 6, 1920, for five "535" foot steamers and had already received two, the *American Legion* and the *Southern Cross*. He asked that the balance be allocated to him as soon as possible as trade conditions with Brazil, Uruguay and the Argentine Republic warranted their being placed in service.

Mr. T. H. Rossbottom of the United States Lines asked for three "535" foot steamers in place of the *Princess Matoika*, the *Hudson* and the *Potomac* for the Bremen route. He also requested that the *Princess Matoika* and *Potomac* should be permanently reconditioned and substituted for the two "502" foot steamers now on the London route.

Committee to Recommend Allocations

Mr. Lasker stated that a committee consisting of Frederick I. Thompson, chairman, and Edward C. Plummer, on trade routes acting with H. S. Kimball, and A. J. Frey, vice-president of the Emergency Fleet Corporation, would investigate the financial status and stability of the companies requiring steamers and make recommendations to the board for allocations.

Conference with Railroads on Foreign Contracts

The United States Shipping Board has announced that all railroads having traffic contracts with foreign steamship lines will be invited to a conference with members of the board at Washington on December 1 to discuss the nature of the contracts and their abrogation if they are found to be detrimental to the development of an American merchant marine.

The Interstate Commerce Commission recently called upon the railroads to file with it copies of such contracts, and this was done by some 28 railroads. There has been much criticism of the contracts by certain members of Congress because in them the railroads frequently made exclusive traffic agreements and extended various privileges to foreign lines which are now regarded as prejudicial to American shipping, although most of the contracts were made many years ago at a time when there was little American shipping.

Cooperation Sought

While some of the speeches regarding these contracts have accused the railroads of alining themselves with foreign interests as against the American shipping, the members of the board, in making the announcement, were careful to refrain from criticising the roads and stated that the roads were to be "invited" to the conference and approached in a spirit of cooperation. It was recognized that the contracts were entered into before this Government had adopted a policy of building up a merchant marine, and it was stated that it was not expected there would be any difficulty in getting together with the railroads upon a plan for coordinating American ocean and rail transportation.

May Substitute Contracts with American Ships

If it is found that the contracts are detrimental to American interests, an effort will be made to substitute contracts with American ships. The Shipping Board will be represented at the conference by Commissioners Thompson, Plummer and Lissner, who are members of the joint committee on interstate commerce and railroad relations, of which members of the Interstate Commerce Commission are also members. Commissioner Thompson proposes to consult with Chairman McChord of the Interstate Commerce Commission and the members of the commission will be invited to attend the conference if they desire. Chairman Lasker, of the Shipping Board, has conferred on the subject with the President.

Developments in Marine Insurance

Hague Rules—Transshipment Premiums—Open Hatches—Temporary Ship Repairs—Salvage Association—Hull Provisions Consistent — Lighterage Clause — Shipboard Fires

By "Bordereaux"

NO other subject has excited so much discussion among marine underwriters during the past month as the advisability of adopting in this country the Hague Rules, 1921, recently formulated by the International Law Association at its Hague meeting. Advocates of the Rules claim them to be little more than a codification of the Harter Act, with the following three major concessions to the cargo interests, for which the latter have been unsuccessfully contending for years:

(1) The carriers are denied the right to limit their responsibility for loss or damage at a lower figure than £100 per package, as against the old customary limit of $100 or less.

(2) The carriers are forced to allow cargo owners twelve months within which to make claims and to bring suits for damage.

(3) The burden of proof, in the matter of theft and pilferage, has been shifted from the cargo owner to the carrier.

It is stated, in explanation of Article VI, to which many cargo underwriters have taken exception, that the attitude of the foreign owners with respect to carriers being allowed freedom of contract as to the terms upon which they shall hold goods before they are loaded and after they are discharged is that before they load cargo and after they discharge it their duties do not differ from those of ordinary warehousemen with whom, in many parts of the world, they are in actual competition; they therefore wish to reserve to themselves such rights as are allowed to other warehousemen.

American marine underwriters, as a rule, do not take kindly to the Hague Rules. They dislike them because they are voluntary, for one thing, and chiefly because it is felt that they give the carriers the best of the case in most of the important particulars. An international bill of lading would be welcomed by them, but the Hague proposals appear to them to offer fewer advantages than the Harter Act, if the latter were properly amended. The proposed condition that neither the carrier nor the ship shall be liable for loss or damage arising or resulting from unseaworthiness, unless caused by want of due diligence on the carriers' part to make the ship seaworthy, is regarded as ingenious and reflects the determination of the carrier to relieve himself and his ship from liability, whereas heretofore the ship has been exempted but not the carrier. It is claimed that the shipper is being asked to waive one of his few remaining defenses, in the matter of unseaworthiness and its warranty; it is practically impossible for the shipper to do as suggested and prove that the carrier did not exercise due diligence. The shipper and underwriter have had no voice in framing the ocean contract and the result is that the latter is a distinctly one-sided document. Obscurity as to just how the Rules apply in vital particulars is also charged against them. One of the foremost marine insurance authorities in this country advises the writer that you can "drive a coach and four through them."

Additional Premium for Transshipments

AS the result of a collision, a week or so ago, cargo had to be transshipped from one steamer of a well-known line to another vessel inferior in many particulars, and the question was again raised as to whether the underwriter was entitled to additional premium in consequence. Where due to the happening of an insured peril the cargo is transshipped to another vessel for the purpose of completing the insured voyage, the underwriter must accept as one of the results of the accident the burden of covering the risk on the poorer substituted steamer. The situation would be different, if the accident were not due to an insured peril; in that case the underwriters would be entitled to additional premium. The point was well illustrated, several months ago, when the *Honolulu* returned to port and transshipped her cargo because of defective stowage. This was not a peril insured against and the underwriters were adjudged entitled to additional premium both for the transshipment and for the substitution of an inferior vessel.

Damage from Open Hatches

THE act of opening and closing the hatches of a ship relates primarily to the custody of the cargo, and is therefore not an act of management of the vessel, is the interesting decision handed down recently in the case of the Andean Trading Company vs. Pacific Navigation Company, 263 Federal Reporter 559. It means that under the Harter Act the owners of the vessel are not freed from liability for damage done to cargo due to the opening and closing of hatches. One of the chief objections of underwriters to the present Harter Act is the fine distinction it draws between what constitutes care and custody of cargo, as distinguished from acts of management of the vessel.

Temporary Ship Repairs

NOW and again the question arises as to the wisdom of permitting insurance companies to be charged for temporary repairs effected for the purpose of avoiding or minimizing delay and in order that a vessel may be kept in freight-earning condition. By way of elucidation it might be added that temporary repairs necessitated by the action of a peril insured against, for which an underwriter may be held liable, are classifiable as follows:

(a) Those prudently effected at a port of refuge because the cost of permanent repairs would be excessive.

(b) Those effected at a port of refuge because of lack of the necessary facilities for the permanent repair work required.

(c) Those made at the port of destination for the same reason as (b), or in order that the vessel may proceed to another port where the damage can be repaired at a less cost.

(d) Those incurred at a port of refuge for the common safety of ship and cargo or the completion of the venture.

(e) In addition to the foregoing there are those repairs which are made by the shipowner with the object of minimizing or eliminating loss of time and these, of course, are of no benefit to the underwriter.

As it would be advantageous to the underwriter that temporary repairs be made in instances (a), (b) and (c), it has been regarded as proper that he sustain the expense so incurred, as well as the cost of permanent repairs later on. Furthermore it should be remembered that where a vessel has been damaged, by a peril insured against, the underwriter has to stand his proportion of the cost of the "particular average" repairs; but he is not liable for the freight loss

which the shipowner suffers on account of the repair work.

But there is a rule of the Association of Average Adjusters of the United States which applies right here. It reads as follows: "The cost of reasonable temporary repairs shall be allowed . . . when the material or parts necessary for permanent repairs are unobtainable at the port where the vessel is, except after unreasonable delay." Also this: "The adjuster shall insert a note in the average statement in explanation of the allowances made."

From this it will be seen that in all cases involving delay in making repairs the liability of the underwriter turns, under adjustments in this country, on the ground of whether an unreasonable delay is incurred in effecting the repairs. Just what constitutes an "unreasonable delay" is not so easy to determine. It must be shown that the time so employed has been unusual and extraordinary as respects the specific repairs under consideration. Information as to the nature of the delay will generally be found in the note in the average statement.

Salvage Association Organized

SYNDICATE "A," of the American Marine Insurance Syndicates, has been withdrawn and in its place there is now being operated the United States Salvage Association, Incorporated, which takes over the business and organization of the former. The entire capital stock of the Salvage Association is held by the subscribers of Syndicate "A." It is a non-profit making body and its purpose is to supply the American shipping trade with a service which shall be the counterpart of that furnished by the Salvage Association of London to British shipping interests. Its agents will be placed in all parts of the world; in fact, through its arrangement with Syndicate "A" it already finds itself equipped with expert representatives at many important ports. It also starts out with "A" 's established offices at Boston, Philadelphia, Baltimore, Norfolk, Savannah, New Orleans, Galveston and San Francisco, with chief headquarters at New York. W. C. Foley heads the surveying staff, with J. A. Wilson as deputy chief surveyor. At the organization meeting the officers were chosen as follows: President, Benjamin Rush; vice-president, Walter Wood Parsons; secretary, Gomer H. Rees; and general manager, Charles R. Page.

Hull Provisions Consistent

OCCASIONALLY some one will start a discussion of the alleged inconsistency in American standard hull policies with regard to those institute clauses that prohibit a vessel from using certain ports or from carrying certain classes of cargo during the currency of the policy and then to hold the assured covered at an additional premium for any violation of this warranty. The annual rate is based on the provisions of the institute clause and owners are held to be governed by the terms of the warranty in the matter of the trades in which they employ their vessels. The secondary clause, to which exception is sometimes taken on the ground of inconsistency, will, for an additional premium, protect the owner of the vessel should the master commit an unauthorized breach of the warranties.

London's New Lighterage Clause

THE Pilferage Committee of the London Chamber of Commerce is in receipt of the terms of a new lighterage clause that is to be operative on January 1. The Association of Master Lightermen and Barge Owners is responsible for the measure. The present clause, which exonerates the carriers from all liability for damage to or loss of goods "howsoever, whensoever, or wheresoever" such damage or loss might be caused, has been the subject of discussion for several months on the part of lightermen, barge owners, merchants and shipping managers in the hope that some modification might be effected in it; and this has at last been secured. Under the provisions of the new clause goods shall be carried only at owners' or customers' risks, "excepting loss arising from pilferage and theft of goods on board the barge whilst in the course of transit—such loss or damage being limited to £50 per ton." The significant point in this new arrangement is the belief that an assumption of financial liability for safe custody best assures due care in the carriage of goods. On January 1 next the British Merchant Shipping Act, 1921, becomes effective. This has the effect of extending to lightermen and barge owners certain privileges respecting the limitation of liabilities for risks incurred in navigation which, at present, are enjoyed by shipowners.

A Round-the-World Risk

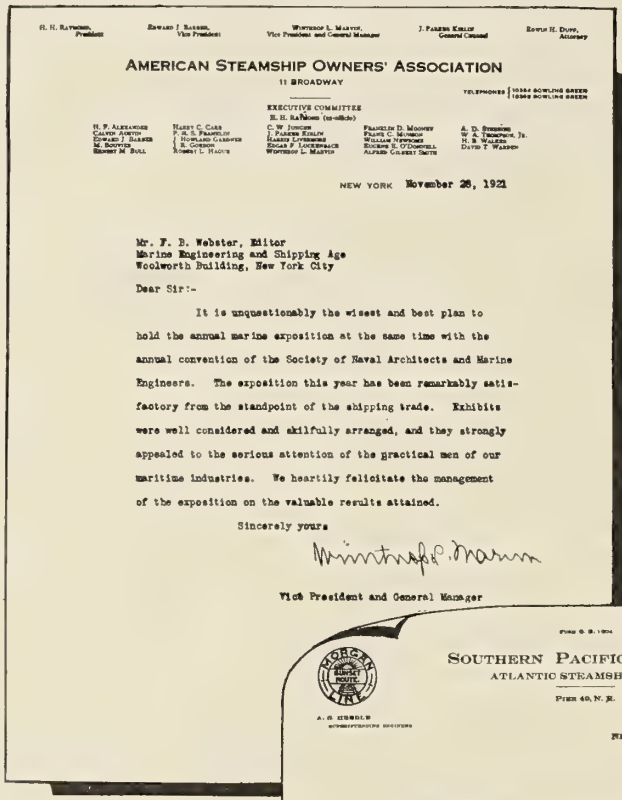
CARGO coverage has been recently effected on the exhibits to be carried by the steamer *St. Louis* on her projected round-the-world voyage. The vessel is now undergoing alterations to fit her for the cruise which will consume eleven months and will carry her to all the principal countries of the world. American exporters are highly enthusiastic over the undertaking. The cover is for about $3,000,000, against all risks on all the exhibits abroad, and is offered on a monthly value-reducing basis. The rate will probably be in the neighborhood of 3 percent.

Shipboard Fires

BOTH underwriters and shipowners are very properly exercised over the the relentless run of serious fires on ships—not quite so numerous this year as last but enough for alarm. Inferior coal and carelessness in bunkering, the latter menace having especially to do with neglect in clearing out the pockets of coal dust in the nearly-emptied bins, are charged with the majority of these disasters. In order to get at the root of the trouble an enquiry was recently undertaken by the London Board of Trade, Lloyds and the Liverpool Underwriters' Association and they have issued a statement, as a result of this investigation, giving details of fire casualties. This document leaves the causes of such fires in doubt but it contains conclusions and recommendations that should go far toward materially reducing this source of loss.

It was found that coal left in bunkers is subject to spontaneous combustion from overheating. Bunkers should be tight in order to prevent air from passing through the coal and thus providing oxygen whose absorption is attended with overheating. Coal left in bunkers should be moved to where it can be used first. Small coal is more liable to spontaneous combustion than large coal. No conclusion was drawn as regards duration of coal storage. Carelessness was found to have caused many shipboard fires, as when a worker drops his lighted match or live tobacco among inflammable goods. Most of the fires occur while the vessel is in port, loading or unloading. Oil-driven vessels contribute numerous fires, resultant from accidental upset or leakage, and the vessel is often totally destroyed as a consequence of difficulty in controlling such casualties. Short circuits of electric wires add their quota, the sparks falling on combustible substances.

Great care should be taken in observing the condition in which certain commodities, subject to spontaneous combustion, are shipped, as well as how they are bagged and stored; among such dangerous merchandise was listed the following: Copra, sugar in bags, cotton, cottonseed, oil cake, coir, nitrate, hemp and jute, old rope, rags and flax waste, sheep skins and fish guano. Water coming in contact with calcium carbide or phosphorus caused several serious blazes. In a word, the chemical forces of nature plus human elements, such as carelessness, have been at the bottom of the great majority of fires on ships. Workmen should be impressed with a proper sense of their responsibility, and ship property will greatly benefit thereby.



AMERICAN STEAMSHIP OWNERS' ASSOCIATION

11 BROADWAY

NEW YORK November 28, 1921

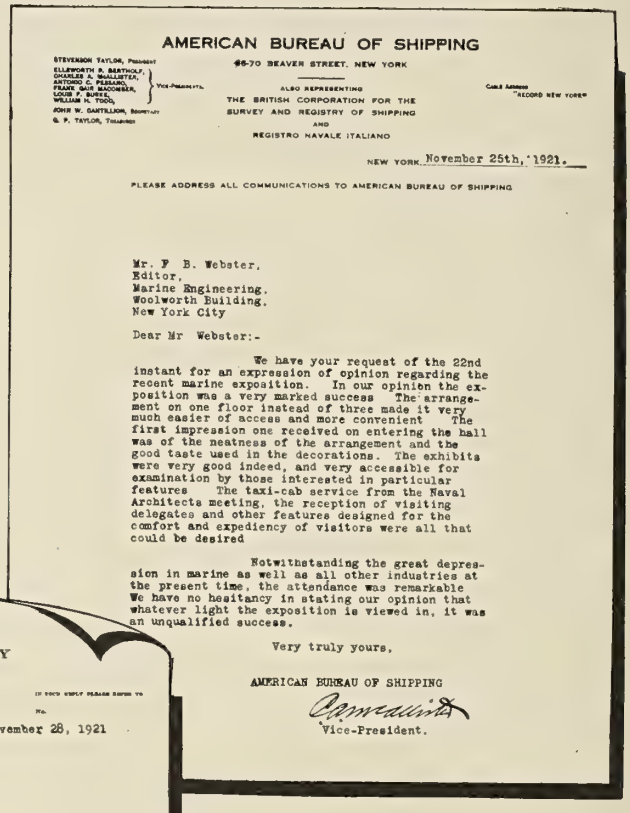
Mr. F. B. Webster, Editor
Marine Engineering and Shipping Age
Woolworth Building, New York City

Dear Sir:-

It is unquestionably the wisest and best plan to hold the annual marine exposition at the same time with the annual convention of the Society of Naval Architects and Marine Engineers. The exposition this year has been remarkably satisfactory from the standpoint of the shipping trade. Exhibits were well considered and skilfully arranged, and they strongly appealed to the serious attention of the practical men of our maritime industries. We heartily felicitate the management of the exposition on the valuable results attained.

Sincerely yours

Vice President and General Manager



AMERICAN BUREAU OF SHIPPING

65-70 BEAVER STREET, NEW YORK

ALSO REPRESENTING
THE BRITISH CORPORATION FOR THE SURVEY AND REGISTRY OF SHIPPING
AND
REGISTRO NAVALE ITALIANO

NEW YORK November 25th, 1921.

PLEASE ADDRESS ALL COMMUNICATIONS TO AMERICAN BUREAU OF SHIPPING

Mr. F B. Webster,
Editor,
Marine Engineering,
Woolworth Building,
New York City

Dear Mr Webster:-

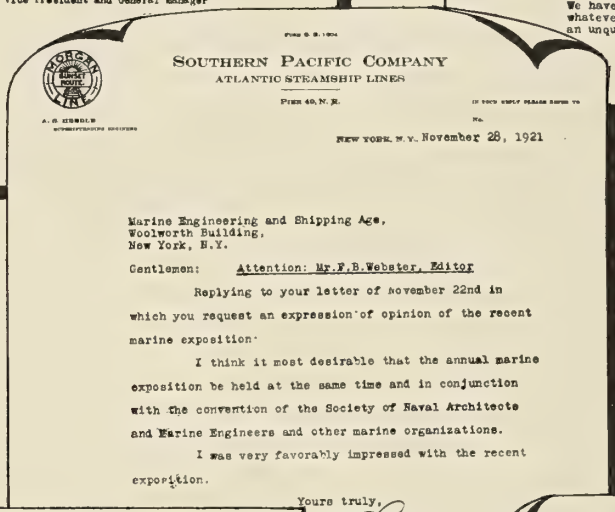
We have your request of the 22nd instant for an expression of opinion regarding the recent marine exposition. In our opinion the exposition was a very marked success The arrangement on one floor instead of three made it very much easier of access and more convenient The first impression one received on entering the hall was of the neatness of the arrangement and the good taste used in the decorations. The exhibits were very good indeed, and very accessible for examination by those interested in particular features The taxi-cab service from the Naval Architects meeting, the reception of visiting delegates and other features designed for the comfort and expediency of visitors were all that could be desired

Notwithstanding the great depression in marine as well as all other industries at the present time, the attendance was remarkable We have no hesitancy in stating our opinion that whatever light the exposition is viewed in, it was an unqualified success.

Very truly yours,

AMERICAN BUREAU OF SHIPPING

Vice-President.



SOUTHERN PACIFIC COMPANY
ATLANTIC STEAMSHIP LINES

PIER 40, N. R.

NEW YORK, N.Y. November 28, 1921

Marine Engineering and Shipping Age,
Woolworth Building,
New York, N.Y.

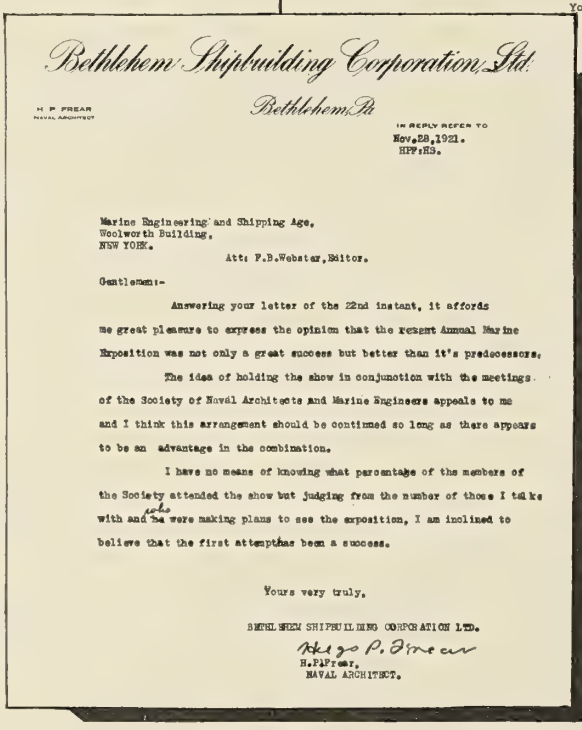
Gentlemen: Attention: Mr.F.B.Webster, Editor

Replying to your letter of November 22nd in which you request an expression of opinion of the recent marine exposition.

I think it most desirable that the annual marine exposition be held at the same time and in conjunction with the convention of the Society of Naval Architects and Marine Engineers and other marine organizations.

I was very favorably impressed with the recent exposition.

Yours truly,



Bethlehem Shipbuilding Corporation, Ltd.

Bethlehem, Pa

H. F. FREAR
NAVAL ARCHITECT

IN REPLY REFER TO
Nov.28,1921.
HFF:HB.

Marine Engineering and Shipping Age,
Woolworth Building,
NEW YORK.

Att: F.B.Webster,Editor.

Gentlemen:-

Answering your letter of the 22nd instant, it affords me great pleasure to express the opinion that the recent Annual Marine Exposition was not only a great success but better than it's predecessors.

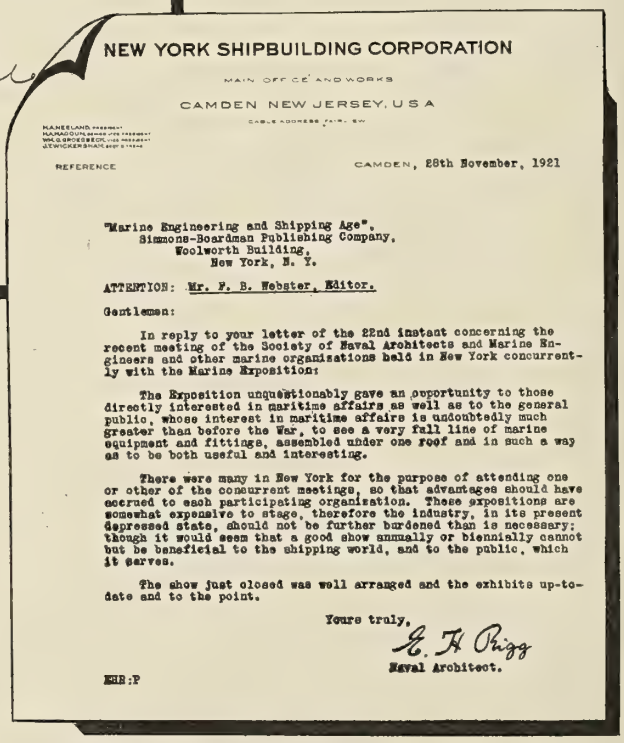
The idea of holding the show in conjunction with the meetings of the Society of Naval Architects and Marine Engineers appeals to me and I think this arrangement should be continued so long as there appears to be an advantage in the combination.

I have no means of knowing what percentage of the members of the Society attended the show but judging from the number of those I talks with and who were making plans to see the exposition, I am inclined to believe that the first attempthas been a success.

Yours very truly,

BETHLEHEM SHIPBUILDING CORPORATION LTD.

H.F.Frear,
NAVAL ARCHITECT.



NEW YORK SHIPBUILDING CORPORATION

MAIN OFFICE AND WORKS
CAMDEN NEW JERSEY, U.S.A.

REFERENCE

CAMDEN, 28th November, 1921

"Marine Engineering and Shipping Age",
Simmons-Boardman Publishing Company,
Woolworth Building,
New York, N. Y.

ATTENTION: Mr. F. B. Webster, Editor.

Gentlemen:

In reply to your letter of the 22nd instant concerning the recent meeting of the Society of Naval Architects and Marine Engineers and other marine organizations held in New York concurrently with the Marine Exposition:

The Exposition unquestionably gave an opportunity to those directly interested in maritime affairs as well as to the general public, whose interest in maritime affairs is undoubtedly much greater than before the War, to see a very full line of marine equipment and fittings, assembled under one roof and in such a way as to be both useful and interesting.

There were many in New York for the purpose of attending one or other of the concurrent meetings, so that advantages should have accrued to each participating organization. These expositions are somewhat expensive to stage, therefore the industry, in its present depressed state, should not be further burdened than is necessary; though it would seem that a good show annually or biennially cannot but be beneficial to the shipping world, and to the public, which it serves.

The show just closed was well arranged and the exhibits up-to-date and to the point.

Yours truly,

Naval Architect.

EHR:P

Shipping and Shipbuilding Executives Endorse Marine Exposition

American Marine Week an Unqualified Success

Marine Exposition the Leading New York Attraction During the Week of November 14-19—Conventions and Committee Meetings of Marine Associations Attract Large Gathering of Shipping Men

WHEN President Warren G. Harding pressed a telegraph key at the White House on November 14 which was the signal for the official opening of the Marine Exposition, he started the first cooperative Shipping and Shipbuilding Show that has ever been staged in this country. As it is known that it is the earnest desire of the President that our merchant marine shall be established on a firm basis during his administration, it is with pleasure that we are able to state that the combined efforts of the principal marine associations to make American Marine Week a real factor in the development of our shipping has met with unqualified success.

The exposition opened at 2 P. M. on Monday, November 14, with nearly all the exhibits in place. The booths throughout were tastefully arranged and decorated, as shown in the accompanying illustrations. In the evening the Robins Dry Dock Marine Band gave a concert and Senator W. M. Calder of New York delivered an address on the American merchant marine.

Senator Calder's Speech

Senator Calder said, in part: "Since my entry into Congress, I have, with other members from this State, urged a policy of Government assistance to passenger and freight vessels operated by Americans in foreign trade. Had we adopted such a policy twenty-five years ago, we would have had a merchant fleet instead of attempting to construct one in the excitement and at the prices produced by the war.

"For many months, Congress labored with the Merchant Marine Act of 1920. The result was enacted in a law now known as the Jones Law. It is generally sound and it is an effective piece of legislation. I know of no legitimate reason, that has as yet been advanced, that would justify us in changing it.

"The Jones Law prescribes trade routes. These services should be administered by great corporations whose stock is widely held. Our people inland must be made to become stockholders in our maritime enterprises. Private ownership of American shipping is specifically prescribed by the law.

"England can operate vessels for one-half the cost to us. Her crews receive 50 percent of the wages paid to our crews. Her supplies cost less. Her construction cost is but 60 percent of ours. Other maritime nations present an even more helpless case. We cannot successfully compete with other maritime nations of the world without government aid.

"It is essential to have a merchant marine for both defensive and commercial reasons. We have probably five million tons of commercially effective shipping. We have in the Jones Law the basis for a sound shipping policy. Our people are interested and have clearly shown that they want a merchant marine. What then are we to do?

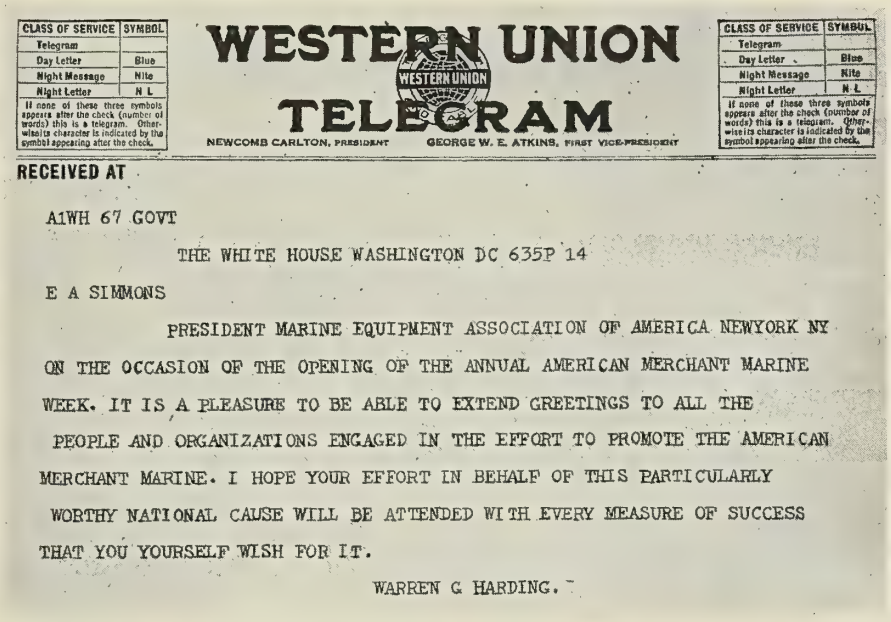
Cooperation of Marine Association Urged

"In the first place, organizations such as the Society of Naval Architects and Marine Engineers, the American Steamship Owners' Association, and others of similar nature should be able to crystallize their ideas into definite form failing to seek personal advantage for any one or any group in a desire to benefit the general proposition. These ideas, commonly agreed upon should be spread broadcast. Educate the public, Educate your Congressmen. But stick to one essential doctrine.

"In the second place, the Shipping Board must and shall take the Jones Law as their Magna Charta. They shall enforce it section for section, paragraph for paragraph, line for line, word for word.

"The better vessels, comprising about one-half of the fleet, should be disposed of as speedily as possible to American companies to be operated under our flag, and the price and terms should be made with a view to their continued operation.

"Third is the duty of Congress. We have done much. We are prepared to do more. We know that there is only one way to build a national merchant marine and that way is to make it commercially profitable. I have no doubt of the probable passing of any measure having that with an object provided it is based upon sound reason. We are entitled to carry at least half of our own commerce both out and in. I believe that other nations of the world would gladly consent to this. I believe Congress will do anything necessary to attain such an objective."



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WESTERN UNION

TELEGRAM

NEWCOMB CARLTON, PRESIDENT — GEORGE W. E. ATKINS, FIRST VICE-PRESIDENT

RECEIVED AT

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THE WHITE HOUSE WASHINGTON DC 635P 14

E A SIMMONS

PRESIDENT MARINE EQUIPMENT ASSOCIATION OF AMERICA NEWYORK NY

ON THE OCCASION OF THE OPENING OF THE ANNUAL AMERICAN MERCHANT MARINE WEEK. IT IS A PLEASURE TO BE ABLE TO EXTEND GREETINGS TO ALL THE PEOPLE AND ORGANIZATIONS ENGAGED IN THE EFFORT TO PROMOTE THE AMERICAN MERCHANT MARINE. I HOPE YOUR EFFORT IN BEHALF OF THIS PARTICULARLY WORTHY NATIONAL CAUSE WILL BE ATTENDED WITH EVERY MEASURE OF SUCCESS THAT YOU YOURSELF WISH FOR IT.

WARREN G HARDING.

Telegram Sent by President Harding at the Opening of the Marine Exposition

Navy Night

On Tuesday evening, Navy Night, the features were an address by Captain R. D. White, U. S. N., inspector of navigational material, stationed at the Sperry Gryoscope Company, Brooklyn, N. Y., and a band concert by the Brooklyn Navy Yard Band of 20 pieces, under the leadership of Alex Morris.

Captain White addressed a large audience at 8:30 P. M.

speaking chiefly on the Navy and giving a few of his views on the proposed international disarmament conference. Captain White stated that it was a question of removing the causes of war and eliminating the friction between nations. He characterized the disarmament conference as one of international justice rather than a court of arbitration. He appealed for a big American merchant marine with a carrying power sufficient to take the greater part of our commerce.

Annual Meeting of the Marine Equipment Association

The annual meeting of the Marine Equipment Association of America was held in the auditorium on the exposition floor at 11 o'clock Wednesday morning. President E. A. Simmons presided. The minutes of the March 28 meeting of the association were read and approved.

President Simmons then outlined the activities of the Executive Committee, officers and members of the various subcommittees since the March 28 meeting. He especially emphasized the work of the Exhibit Committee, to which he attributed the success of the exhibition. He further pointed out the possibilities that lie before the association in its determination to function in the marine fields as a Chamber of Commerce and in making "American Marine Week" a national feature in the events of the country.

In order that the name of the association may more correctly indicate its membership and the character of the work it proposes to do it was recommended that the name be changed to Marine Association of America. Action will be taken by the Executive Committee at its next meeting—December 12.

Preliminary figures submitted by the treasurer showed conclusively that the receipts would exceed the expenditures; but a definite statement was not possible because of the uncertainty of income from paid admissions and concessions during the show and certain incidental expenses.

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Col. E. A. Simmons, President, Marine Equipment Association

Col. Edward A. Simmons, of Marine Engineering and Shipping Age, was re-elected president, while W. M. Wampler, of the Elcon Company, was elected vice-president. The Nominating Committee recommended to the Executive Committee that H. C. Davis, of Row & Davis, Engineers, Inc., be reappointed treasurer and Robert B. Lea, of the Sperry Gyroscope Company, secretary to succeed K. L. Ames, Jr., of the American Steel Foundries, resigned.

The following were chosen members of the Executive Committee to succeed those whose terms expire at the end of this year: First district (New England states), Albert C. Ashton, Ashton Valve Company, Boston, Mass., and E. S. Sanderson, Scoville Manufacturing Company, Waterbury, Conn.; second district (New York and New Jersey), Gardner Cornett, Pneumercator Company, New York City; third district (Pennsylvania, Maryland, Delaware, District of Columbia, Virginia and West Virginia), W. P. Smith, William Cramp & Sons Ship & Engine Building Company; fifth district (states contiguous to the Great Lakes and the Middle West), Benjamin Neilds, Jr., National Malleable Castings Company (Cleveland), New York City; and sixth district (Pacific Coast), K. W. Heinrich, Bethlehem Shipbuilding Corporation, Ltd. (California yards), Bethlehem, Pa.

Events of Steamship Owners' Day

The technical committee of the American Steamship Owners' Association inspected the exhibits at the Marine Exposition Wednesday afternoon. After spending two hours and a half examining the latest types of marine equipment, they unanimously agreed that this year's exposition was a credit to the industry.

In the evening Mr. Winthrop L. Marvin, vice-president and general manager of the American Steamship Owners' Association, delivered an address at the exposition on the merchant marine. "This is the best marine exposition that I have ever seen," said Mr. Marvin in acknowledging his introduction by Colonel E. A. Simmons, president of the Marine Equipment Association. Taking up the problem of the merchant marine, Mr. Marvin said, in part:

"The problem of the American merchant marine is not merely a problem of the Shipping Board. On the contrary, out of our whole merchant shipping, on lake, river and ocean, the Shipping Board owns 8,000,000 out of about 19,000,000 tons gross register.

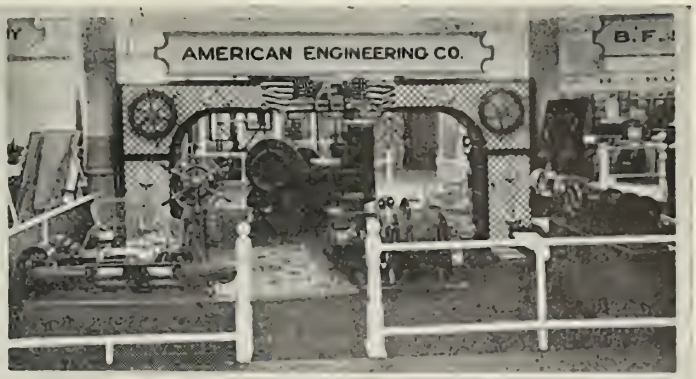
Congress by an overwhelming majority in the Jones law has proclaimed that Shipping Board vessels must be transferred to private ownership 'as soon as practicable.' Therefore, the question of the permanent development of our merchant shipping is a question of the development of an American industry like any other great industry, owned by private capital and directed by private enterprise, but of vital concern to the whole people of the United States.

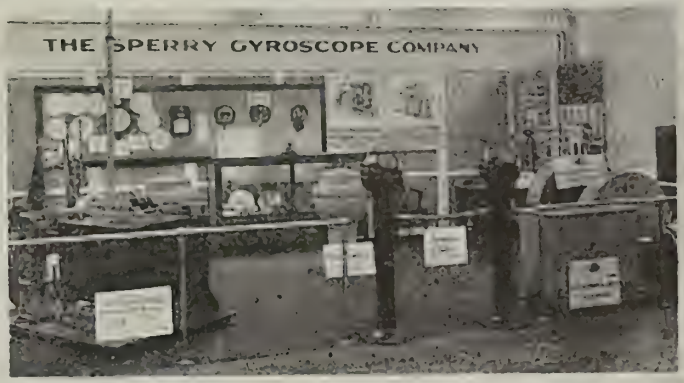
"American shipowners began two years ago to prepare for the ending of the highly speculative era in the shipping business which had begun with the outbreak of the European war. First, overhead costs were vigorously retrenched. Salaries and wages of the staffs on shore were reduced from top to bottom. Space was economized. Rentals were cut down. Every possible effort was made to enforce efficiency and at the same time to achieve lowered costs of operation. Finally, starting in the spring of this year, last of all, there was brought about a substantial reduction of the war-time pay of seagoing officers and men.

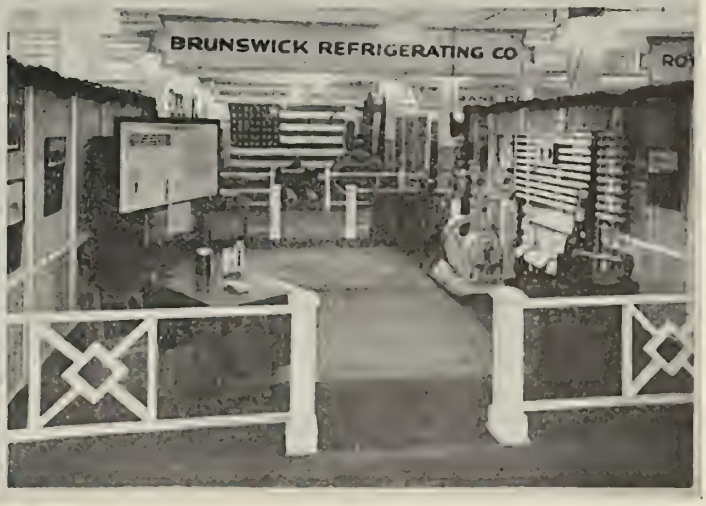
"American shipowners foresaw the coming of this time of shrinking trade and intensified competition and manfully prepared to meet it. They were not taken by surprise. In February, 1920, they were denounced for asking the Government to sell its war-built steamers for $100 per deadweight ton. But the Government refused and set a price of $165 and upward. Now these same ships could not be sold for $50, so low have freights and prices fallen throughout the world.

"It is in a time of extreme difficulty and depression that the American people are now confronted with the need of an enduring solution of the problem of the merchant marine. But American shipowners, men of experience and courage, believe that the question can be solved by vigor, economy and aggressiveness on their part, united to a reasonable policy of cooperation from their Government. They say: 'Revise the navigation laws—but do not depend upon that alone to accomplish everything, for it will not; protect and aid shipping as manufacturing and agriculture have been aided and protected—this also must be done.' Ocean ship-

Views of Exhibits at the Marine Exposition







ping is the most intensely competitive of industries. There is more need of National aid there, and more justification for it, than anywhere else. Enforce all that is sound and effective in the Jones law.'"

THURSDAY, NAVAL ARCHITECTS DAY

The annual convention of the Society of Naval Architects and Marine Engineers was opened in the Engineering Societies building, 29 West 39th street, New York, Thursday morning at 10 A. M., with Rear-Admiral Washington L. Capps, U. S. N., president of the society, in the chair.

The proceedings are reported in full in another part of this issue.

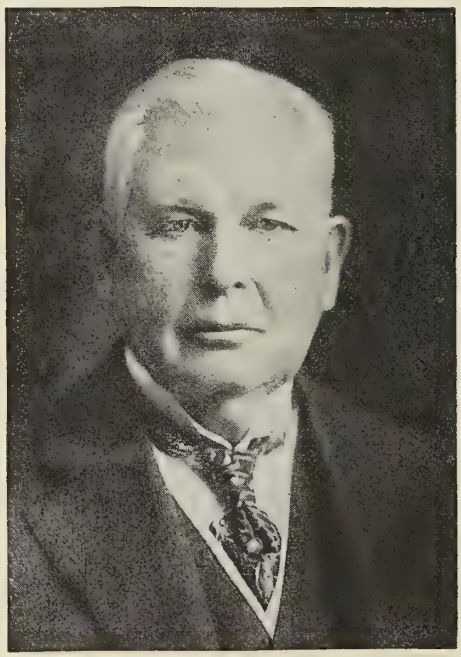
AMERICAN BUREAU OF SHIPPING

Rear-Admiral W. L. Capps, U. S. N., president of the Society of Naval Architects and Marine Engineers, and Stevenson Taylor, president of the American Bureau of Shipping, were hosts at a combined luncheon given at the Engineers' Club, 32 West 40th street, Thursday, November 17, at one o'clock, to the members of the Council of the Society of Naval Architects and Marine Engineers and members of the technical committees of the American Bureau of Shipping. The membership of these two bodies includes many of the leading naval architects, marine engineers and shipbuilders in the United States and the luncheon gave them an opportunity to discuss informally professional matters of vital importance to the marine industry. This meeting was called in conjunction with the Marine Exposition and the convention of the Society of Naval Architects and Marine Engineers.

H. H. Raymond, President,
American Steamship Owners' Association

Among those present at the luncheon were Rear-Admiral J. K. Robison, U. S. N., engineer-in-chief of the United States Navy; Rear-Admiral W. L. Rodgers, U. S. N., Captain Q. B. Newman, engineer-in-chief of the United States Coast Guard; Major Frank Van Vleck, superintending marine engineer of War Department, Washington, D. C.; Commodore W. E. Reynolds, commandant U. S. Coast Guard; C. A. McAllister, vice-president, American Bureau of Shipping; Charles F. Bailey, chief engineer, Newport News Shipbuilding & Dry Dock Company; Robert Warriner, chief engineer, Bethlehem Shipbuilding Corporation, Ltd.; Naval Constructor E. C. Gillette, superintendent of naval construction, United States Lighthouse Service; E. G. Tuck, chief surveyor, American Bureau of Shipping; David Arnott, deputy chief surveyor, American Bureau of Shipping; W. M. McFarland, president-elect of the Society of Naval Architects and Marine Engineers and manager, marine department, of the Babcock & Wilcox Company. H. C. Higgins, consulting engineer, New York; A. H. Hebble, superintending engineer, Southern Pacific Steamship Company; Charles Skentelbery, marine superintendent, Warren Transportation Corporation, Boston, Mass.; Thomas F. Rowland, Jr., president, Continental Iron Works, New York; James Donald, naval architect, New York; Hugo P. Frear, naval architect, Bethlehem Shipbuilding Corporation, Ltd.; Frank E. Kirby, naval architect, New York; H. A. Magoun, vice-president, New York Shipbuilding Corporation; Professor H. C. Sadler, head of department of naval architecture, University of Michigan; F. L. DuBosque, superintendent floating equipment, Pennsylvania Railroad; W. L. R. Emmet, consulting engineer, General Electric Company; Dr. W. F. Durand, Leland-Stanford University; H. L. Aldrich, New York; E. H. Rigg, naval architect, New York Shipbuilding Corporation; E. C. Bennett, general manager, Newburgh Shipyard; W. H. Todd, president, Todd Shipyards Corporation, New York; N. E. McClelland, naval architect, Montreal, Can., and N. J. Pluymert, Jr., naval architect, Standard Transportation Company, New York.

After the luncheon, those present attended the Marine Exposition and the meeting of the Society of Naval Architects.



Stevenson Taylor, President
American Bureau of Shipping

Through the courtesy of the United States Coast Guard Service, the new electric drive cutter *Tampa* was opened for examination to members of the Society of Naval Architects and Marine Engineers and to guests of the Marine Equipment Association of America.

The *Tampa* was moored all day Thursday and Friday and Saturday morning at Pier 59 of the International Mercantile Marine Company, at the foot of West 18th Street. Many engineers availed themselves of the opportunity to see the propelling machinery of this vessel, which consists of two Babcock & Wilcox oil burning watertube boilers supplying steam at 200 pounds gage pressure and 50 to 75 degrees superheat to a Curtis turbine direct connected to an alternating current generator supplying electric power to a 2,600 horsepower synchronous motor giving a propeller speed of 130 revolutions per minute.

THURSDAY EVENING, SHIPBUILDERS NIGHT

During the evening a concert was rendered by the Tietjen & Lang Dry Dock Marine Band. The shipbuilders, naval architects and marine engineers attended the exposition in large numbers. The delegates to the American Society of Marine Designers inspected the show in a body.

FRIDAY, NAVAL ARCHITECTS DAY

Friday was indeed a busy day with the conventions of the societies of Naval Architects and Marine Engineers and the American Society of Marine Designers in session. Every shipbuilder who could possibly get away from his work was in New York Friday to attend the exposition, the conventions and the annual banquet of the naval architects.

Views of Exhibits at the Marine Exposition

SATURDAY, MARINE DESIGNERS DAY

Through the courtesy of the Shipping Board, the *Leviathan*, America's largest passenger ship, and the *Victorious*, the latest freighter to be equipped with electric drive, were open to inspection. Tugs took the naval architects, marine engineers and guests of the Marine Association from the International Mercantile Company's pier, No. 59, to the Hoboken dock where the ships were moored. A large number of prominent men took advantage of this opportunity, which was really one of the best features of the week. To describe the *Leviathan* would require a feature article, but some idea of this giant ship may be obtained from a statement made by Mr. A. G. Rossell to the effect that it would cost the companies who are making a real estimate on reconditioning this boat between $40,000 and $50,000 each to submit their bids. The specifications for this work comprise twelve volumes in addition to two volumes of photographs.

The *Victorious*, although moored to the dock, ran a series of reversals from full speed ahead to full speed astern under the personal direction of H. B. Taylor, chief turbine engineer for the Shipping Board. The rapidity with which the motor can be brought to a stop from full speed ahead and then reversed to full speed astern through both its magnetic and manual controls was a revelation that was fully appreciated by the prominent shipping men who visited the ship during the day. The *Victorious*, re-engined by the Todd Shipyards Corporation, is a vessel of 12,000 tons deadweight with a turbo-electric installation of 3,000 shaft horsepower, furnished by the General Electric Company. The turbine and generator operate at 3,000 and the motor at 100 revolutions per minute at full speed. Steam is generated in three Scotch boilers, fitted with Foster superheaters of the firetube type, at 200 degrees superheat.

CONVENTION OF MARINE DESIGNERS

The tenth annual convention of the American Society of Marine Designers opened Friday, November 18, in the auditorium of the exposition, delegates from all branches of the organization being present. The convention was called to order at 10 A. M., by the president of the New York branch No. 23, Mr. W. W. Robertson, who welcomed the officers and delegates of the organization to the city and complimented them on their loyalty to the society.

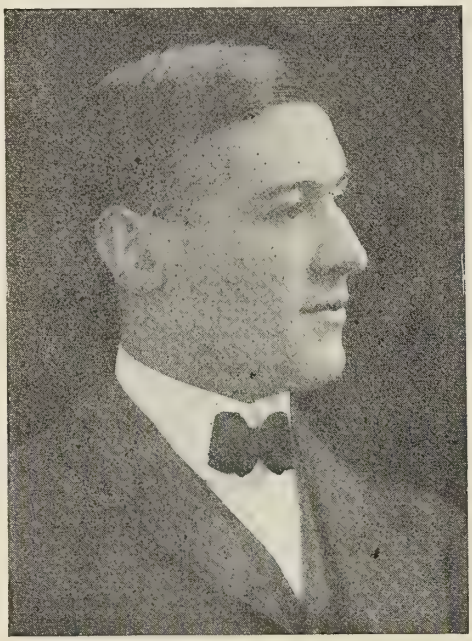
Mr. C. E. Deiser, national president, responded briefly and called for delegates' credentials. The reports of all the standing and special committees were then received, which was followed by the reports of the secretaries of the various branches, all reporting a belief that there would be a change for the better in the very near future.

The election of officers resulted as follows:

President, E. H. Monroe, Washington, D. C.; vice-president, C. C. Jacobson, New York City; secretary, B. G. Barnes, Quincy, Mass.; treasurer, J. B. Sadler, Norfolk, Va.; executive committeemen, John Thomson, Bethlehem, Pa., A. H. Haag Baltimore, Md., and C. D. Anderson, Washington, D. C.

It was voted to change the name of the society from the American Society of Marine Draftsmen, as it was formerly known, to American Society of Marine Designers.

The next convention will be held under the auspices of the Delaware River Branch, at Philadelphia, Pa.



E. H. Monroe, President-Elect, American Society of Marine Designers

PURPOSE OF SOCIETY

The American Society of Marine Designers is an organization promulgated among technical men engaged in the marine drafting profession of the United States to promote their general welfare professionally, intellectually and socially and to cultivate the highest standard of professional ethics among them. At a convention held in Philadelphia from December 2 to 4, 1912, delegates representing fourteen ship and navy yards completed the organization of the society and elected officers consisting of William S. Haney, of William Cramp & Sons Ship & Engine Building Company, president; Sanford C. Jenkins, of the Newport News Shipbuilding & Dry Dock Company, vice-president; Sanders Van Auken, secretary and treasurer.

The executive committeemen elected were J. Emile Schmeltzer, now assistant general manager, Merchant Shipbuilding Corporation, and Perry K. Thurston, of the Navy Department, Washington, D. C.

From 1912 on the society grew in leaps and bounds and by 1914 no less than 24 branches were established in all parts of the country. During the war, new branches sprang up and swelled the membership but with the signing of the Armistice and the slackening off of work in the shipyards a number of these branches went out of existence.

The Society of Marine Designers is doing good work in a large way among the marine draftsmen and should be encouraged in every way. At the present time there are 12 branches.

PROCEEDINGS

In addition to changing the name of the society to American Society of Marine Designers, it was decided to institute an active campaign to secure positions for those of its members and ex-members who are at present out of work. Engineering firms will be furnished with a list of names of men of high calibre and character who are at present unemployed and these firms will be requested to send their inquiries for engineers to the secretary of the society.

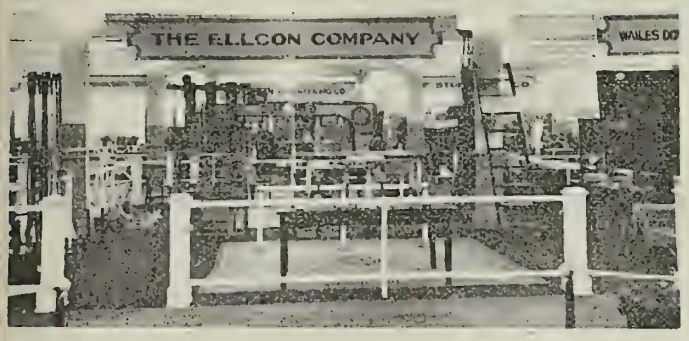
A number of technical papers were read at the Saturday afternoon session and a banquet was given Saturday evening at the Hotel Breslin.

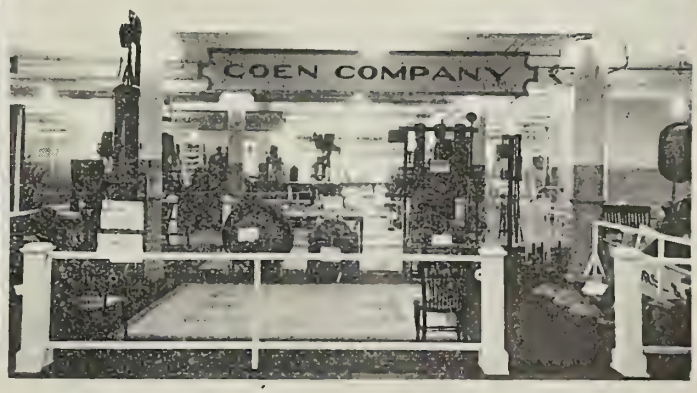
OUR DAILY EDITION

An outstanding feature of the show was the Daily Edition of MARINE ENGINEERING AND SHIPPING AGE. It contained condensed reports of all the principal happenings of interest during the week, the various conventions, etc., and, in addition, kept the exhibitors in daily attendance in close touch with what was transpiring in the way of new work and contracts placed in the marine field.

In this connection it is a noteworthy fact that "The Daily" placed before its readers information on all classes of marine work, such as new vessel construction and repairs and port and pier developments, having a total estimated valuation of more than $20,761,000, which goes to show that the editorial staff, while "covering" the many phases of the exposition and its incidental attractions did not lose sight of the thing closest to the heart of shipbuilders, repair and equipment men—*contracts*. MARINE ENGINEERING AND SHIPPING AGE also provides a daily report of general marine information which is broadcasted by wireless from Newark, N. J.

Views of Exhibits at the Marine Exposition

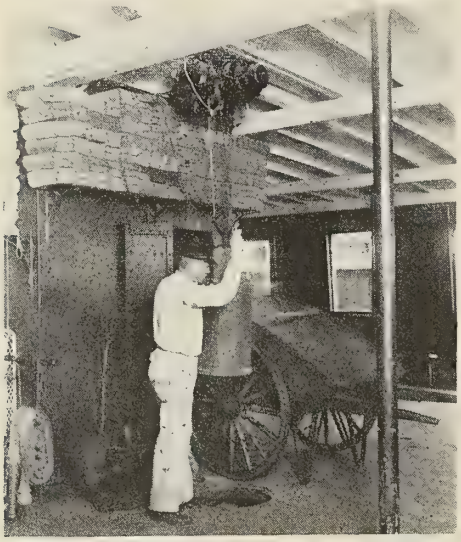




New Devices Exhibited at the Marine Exposition

Small Capacity Mono-rail Hoist for Marine and Terminal Service

THE new ton and half-ton mono-rail hoists developed by the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., are adaptable to many uses where small controlled hoists are required for the rapid handling of materials. Probably their greatest use in the marine field is in freight handling operations at terminals, ash handling on board ship and the like, while in shipyards and manufacturing plants they are useful for moving materials in process of fabrication.

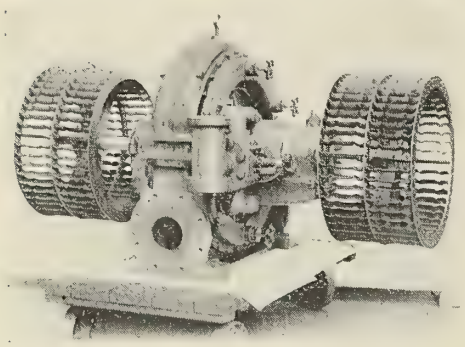


Shepard Electric "Liftabout" Handling Ashes on Board Ship

The new "Liftabout" as it is known has the Shepard type of balanced drive and an oil bath system of lubrication for gears and running parts. All mechanical and electrical units are enclosed in tight metal housings which exclude dirt, dust, fumes and dampness. These hoists are equipped with Zobell motors especially designed for hoisting service and arranged for variable or constant speed as desired. The hoisting and traversing motions are controlled from the floor by means of two operating cords attached to controlling levers.

New Special Service Blowers

AT the exhibit of the B. F. Sturtevant Company, Boston, Mass., two types of naval blower units were shown. Features of one of these, the scout cruiser type known as V D-7, are split bearing casings for ready access to the bearings and an improved speed regulating governor.



Closed Fireroom Forced Draft Blower

The second blower, known as C-12, is for use in connection with closed fire room systems of forced draft. In this machine the fan bearings are eliminated by designing the machine with overhanging fans. The shorter base with space and weight savings is also a feature of this type, in addition to the elimination of alinement troubles.

Longitudinally Trussed Dry Dock

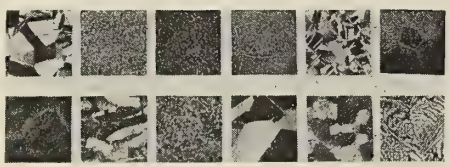
THE model of a 5,000-ton sectional dry dock of rigid construction was shown by the Crandall Engineering Company of Boston, Mass. Rigidity and strength are obtained in this type dock by building each section as the panel of a Warren pin truss. These sections when connected, it is claimed, give a strength to the structure comparable with a solid wing wall dock. The largest dock of this type so far built is of 8,000 tons at the yard of the Bruce Dry Dock Company, Pensacola, Fla.

Rotary Pump for Heavy Liquids

A ROTARY pump consisting essentially of a double cylinder through which liquids are forced by two meshing cams was shown by the Northern Fire Apparatus Company, Minneapolis, Minn. Pilot gears are attached to the ends of the cam shafts and a rotary motion transmitted to one of the shafts operates both cams. Close contact between the cam teeth and the cylinder is provided by small blades inserted in the teeth which are held out against the cylinder walls by means of light springs.

Non-Ferrous Metals Exhibit

A DEMONSTRATION of the application of metallography to the study of brass was given during the Exposition at the booth of the Scovill Manufacturing Company of Waterbury, Conn. Samples of corroded and season cracked condenser tubes were shown which indicated the inner structure of the metal and what actually happens when condenser tubes fail in service.



The Microstructure of Brass

The accompanying illustration represents sections of various brasses which were studied under the microscope after they had been subjected to a variety of treatments.

Exit the Rivet Passer

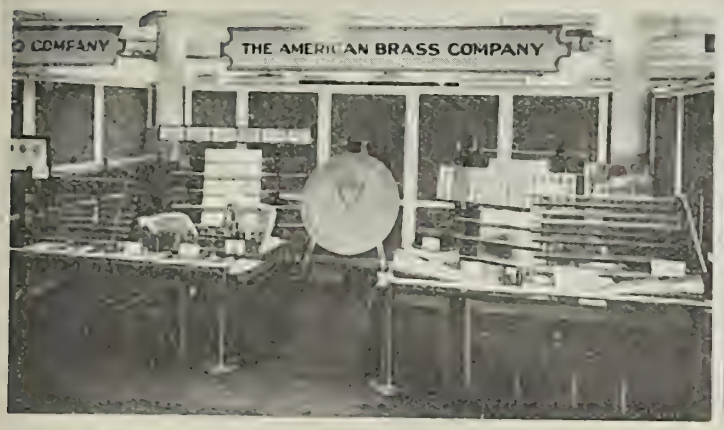
THE Harrold rivet gun, exhibited in the booth of the American Car & Foundry Company, at the Marine Exposition, is a new device which is being used by the Federal Shipbuilding Company for passing rivets automatically instead of by hand from the rivet heater to the holder-on. The device can be attached to the rivet heating forge and operated by the rivet heater. Two riveting gangs working close together can be served by one heater. A reduction of loss of time and accidents is claimed for this device.

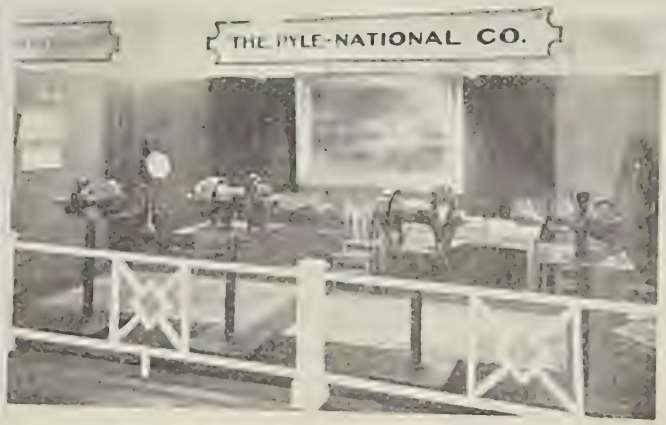
Safety Blocks Exhibited

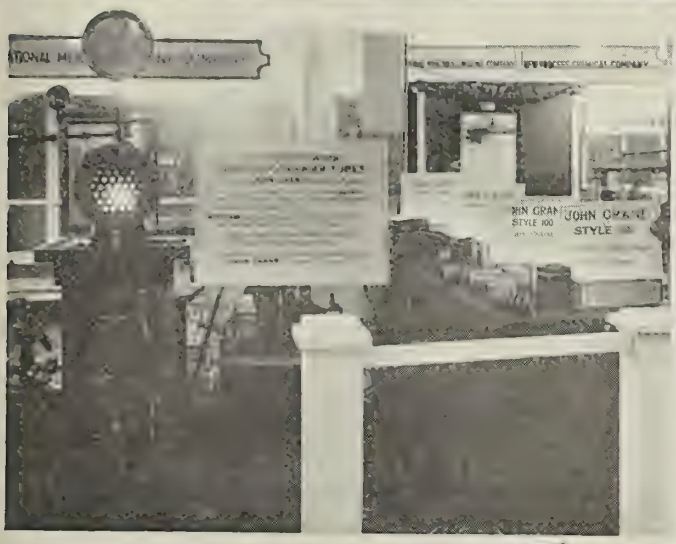
TWO blocks recently developed at the Marine Decking & Supply Company's works at Easton, Pa., were shown at the Exposition. One of these includes a safety feature consisting of a fork contrivance to insure positive stop at any desired position of a load.

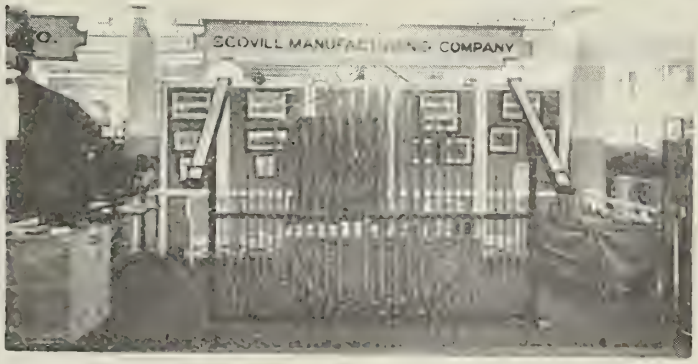
The second block embodies an improvement over the ordinary snatch block, obtained by fitting a pair of sister hooks in place of the customary swivel hook and link. After being

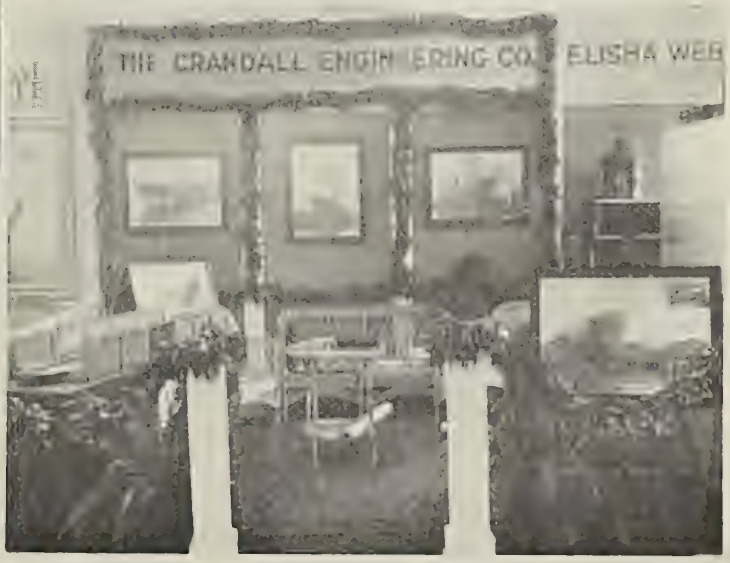
Views of Exhibits at the Marine Exposition











Views of Exhibits at the Marine Exposition

attached to a fall, the sister hooks are held in position by wire mousing which prevents the hook from becoming detached from the fall.

Valveless Reciprocating Pump

A NEW type valveless reciprocating pump invented by H. A. Danstrup and Joseph Harrison and developed by the Clinton Dry Docks, Brooklyn, N. Y., was shown for the first time at the booth of the Todd Shipyards Corporation.

This pump consists of a piston actuated by a crank and a set of gears at the end of the crank shaft which operates a cast steel disk, cored in such a manner as to open and close two ports in the cylinder. The pump is designed for handling any liquid, but is especially recommended for molasses or heavy oil. It is claimed that a continuous flow of liquid is insured by the constant vacuum maintained in the pump.

Marine Auxiliary Motors

TWO new motors, the C O M and the R C M types built for use with deck machinery and for below deck auxiliaries respectively, were exhibited by the General Electric Company, Schenectady, N. Y. The C O M type for deck machinery is specially constructed to withstand the severe weather conditions at sea.

The R C M motor for continuous duty with below deck auxiliaries has a special system of ventilation which permits the use of motors of maximum size and rigidity, while at the same time preventing the entrance of dripping or splashing oil, water and the like.

The C O M motor was shown at the General Electric booth while the R C M motor was connected to a centrifugal pump at the booth of the C. H. Wheeler Manufacturing Company, of Philadelphia, Pa.

Electrically Driven Auxiliaries

A PORTABLE electric winch having one drum and two "niggerheads" built for the Department of Docks, New York City, was exhibited by the American Engineering Company, Philadelphia, Pa. With a 4,000-pound load this hoist has a lifting speed of 200 feet per minute and a rapid light hook lowering speed. A dynamic brake insures immediate stopping of the hoist when the current is shut off.

Other equipment in the exhibit of this company included an electro-hydraulic reduction gear, consisting of a variable stroke, constant speed, reversible rotary pump and a rotary reciprocating hydraulic motor, oil actuated, the speed being controlled by changing the stroke of the pump from zero to a maximum; a spur gear windlass and electric gypsy, the former having a head locking arrangement and both being driven by variable speed motors; and an electro-hydraulic steering arrangement which demonstrated the complete equipment necessary for handling a vessel, including a pilot house stand, hydraulic telemotor and the steerer itself.

Meeting of Naval Architects and Marine Engineers Feature of "American Marine Week"

Walter M. McFarland Elected President—Present Problems in Ship Construction and Operation Discussed—Rapid Return to Normal Conditions Predicted

THE annual convention of the Society of Naval Architects and Marine Engineers was opened in the Engineering Societies Building, 29 West 39th street, New York, on November 17 at 10 A. M., with Rear-Admiral Washington L. Capps, U. S. N., president of the society, in the chair.

The report of the secretary-treasurer showed that the membership as of October 31 was 1,695 as compared with 1,771 at the close of the annual meeting in 1920. However, the applications of 100 new candidates for membership were accepted at the morning session and many more were admitted during the convention. The report also showed that the financial condition of the society was very satisfactory.

Election of Officers

The following officers were elected for the terms specified:

President—(For the three years ending December 31, 1924)—Walter M. McFarland.

Vice-President—(For term expiring December 31, 1924)—Lewis Nixon, H. I. Cone, C. H. Peabody, J. W. Powell.

Members of Council—(For term expiring December 31, 1924)—Andrew Fletcher, J. H. Mull, C. W. Dyson, R. H. M. Robinson, W. G. Coxe, Robert Haig.

Associate Members of Council—(For term expiring December 31, 1924)—E. M. Bull, J. N. Pew, Jr.

Executive Committee — Stevenson Taylor, W. L. Capps, Andrew Fletcher, F. L. DuBosque, J. W. Powell.

Committee on Papers—F. L. DuBosque, J. Howland Gardner, H. L. Aldrich.

Secretary and Treasurer—Daniel H. Cox.

Walter M. McFarland, President-Elect of Naval Architects' Society

In his annual address, Rear-Admiral Washington L. Capps, U. S. N., president of the society, said, in part:

Abstract of President's Address

Twice during the past three years, the annual meeting of our society has been coincident with events which are epochal in the world's history. These events must necessarily have a profound effect upon the "promotion of the art of shipbuilding, commercial and naval," the object as stated in our constitution, for which this Society of Naval Architects and Marine Engineers was founded.

On November 11, 1918, was concluded an armistice which virtually ended a war greater in magnitude and in world significance than pre-war historians would have dared imagine.

Great as has been the industrial upheaval due to the world war, serious as may now appear the conditions which prevail in that industry which is the especial concern of the members of this society, it is hoped and believed that the return to normal conditions will be much more rapid at this time than at the conclusion of any of the other great world crisis. In view of the tremendous changes which have taken place in world shipping, ship construction and world trade during the last few years, it will be worth our while to note briefly some of the changes.

In 1914, the world's gross tonnage in vessels of 100 tons, or more, was approximately 49,000,000 tons. Of this, more than 42,000,000 tons was *steel steam* tonnage. In 1921, the gross *steel steam* tonnage alone had increased to nearly 55,000,000 tons. Of the total world ship tonnage of 49,000,000 tons in 1914, the United States had in overseas trade only 1,100,000 tons, while the gross United States *steam* tonnage engaged in overseas trade in 1921 was practically ten times the 1914 figure. Of this enormous expansion of United States ocean-going tonnage, approximately 8,000,000 tons were contributed by the Government of the United States through its authorized agency, the United States Shipping Board, and the cost of this additional tonnage, due largely to war conditions, was virtually equal to that of the entire pre-war world tonnage.

As opposed to the great increase in *overseas* tonnage, it is worthy of note that the increase in United States tonnage engaged in *domestic* trade in the 7-year period from 1914 to 1921 was comparatively insignificant, being less than 5 percent.

It is also interesting to note that the total increase in world tonnage in the 7-year period preceding and following 1914 was approximately 10,000,000 tons, the percentage increase for the 7-year period 1907-1914 being really greater than that for the 7-year period which included the war expansion.

Nor were the increases in American trade in American bottoms less significant than the increases in American overseas tonnage.

The entries and clearances of United States vessels in North American trade had increased from 26,000,000 tons in 1914 to 46,000,000 tons in 1921, while the overseas trade had increased from 1,700,000 tons in 1914 to 22,000,000 tons in 1921. The corresponding United States trade carried in *foreign* bottoms decreased from 31,000,000 tons of entries and clearances in 1914 to 25,000,000 tons in 1921, while the *overseas* entries and *clearances* of United States trade in *foreign* vessels *decreased* from 48,000,000 tons to 45,000,000 tons in the same period. We thus had, during the 7-year period, 1914 to 1921, a tremendous increase in *overseas* entries and clearances in United States vessels, with a slight decrease for foreign vessels, the net result being, of course, a very great increase in United States world trade.

In further illustration of the great change which has taken place in recent years in American steam steel tonnage, it is worthy of note that while the increase in this tonnage for the period 1907-1914 was approximately 50 percent,

the increase for the following 7-year period was nearly 300 percent. Moreover, in 1914, the United States had less than 10 percent of the world's steel tonnage; it now has approximately 26 percent of the total.

When we note the variations in quantity of steel ship construction for the period in question, the facts are even more startling. In 1915, the total tonnage of ocean-going steel vessels of more than 1,000 tons gross register constructed in the United States was approximately 112,000 tons. In 1920, this had increased to nearly 2,900,000 tons, or more than 2,500 percent. Now, however, building programs are nearly completed and the actual merchant ship steel steam tonnage under construction, as reported by Lloyd's Register for the quarter ending September 30, 1921, is approximately 420,000 tons for the United States and 4,550,000 for the rest of the world.

As in the days of the sailing clipper ship when the American shipbuilder excelled all others and the American Merchant Marine was at the forefront in tonnage and efficiency, we may confidently look forward to a period when efficiency of design, construction and operation of the power-driven cargo and passenger vessels of the future will place the United States again among the leaders of maritime development, and it is to be hoped that the rivalry through which such results may be accomplished will be of an entirely friendly character largely as represented by passenger and cargo vessels rather than by vessels primarily designed for destructive purposes.

Development of the Three-Plane Navy, With or Without Battleships

By Mason S. Chace

ABSTRACT

THIS paper presents the question as to whether in the development of three-plane navies, including surface vessels, submarines and air forces, the battleship will maintain, or will lose, its superiority as the backbone of fighting fleets.

I have expressed the opinion that much still remains to be done in the way of developing the submarine, that aviation stands today as a new powerful arm of offense and defense which only through development and use can be made dependable; also, that the only defense against the attacks of air forces is the use of other air forces.

Attention is called to the fact that large high-explosive bombs carried by aeroplanes and dropped into the water alongside of a vessel can sink or seriously damage any naval vessel now in existence; and, that it would not seem to be practicable to construct vessels of sufficient strength to withstand the effect of such bombing. Underwater damage has been especially referred to, as damage under water affects both buoyancy and stability and is much more dangerous to the life of a ship than is damage above water. The local destructive effect of explosive bombs dropped on the deck of a ship can be sufficient to put that ship out of action. Ships with decks sufficiently well armored to withstand the plunging fire of heavy artillery will be to a great extent protected against the penetration of armored decks by bombs dropped from aeroplanes. The detailed possibilities of the use of aero-torpedoes, aeroplane gas attacks, smoke screens, etc., have not been gone into in this paper. The importance of the use of such methods of attack is evident.

In view of the fact that the battleship has about reached the practical limit in the way of further increase of its dimensions and consequently increase in its defensive strength; also, because its offensive strength can only be slightly increased by increasing the calibre of the guns of its main battery, it is considered that further important developments of the battleship are improbable, if not impossible.

The bomb carrying aeroplanes are considered as long range guns, capable of dropping various kinds of shells and depth bombs, which planes are to be transported to the zone of operation by the aeroplane carrier ships. It is concluded that the aeroplane carrier ships which transport the scouting, fighting and bombing planes will become the ships from which the naval engagements of the future will be carried on and directed.

In the present embryo stage of development of aviation for commercial purposes, as well as for use in warfare, I do not consider it possible to define its probable development and the specific uses which may be assigned to both lighter-than-air and heavier-than-air machines. I believe that in the three-plane navies of the future, it remains further to develop the submarine, which in the World War surprised us by its work and development, that the surface forces can be but little developed and that the greatest possibilities and probabilities of development are in the air forces, which air forces are to become of supreme importance.

There was no discussion of this paper.

The Tactical Relations Between Different Classes of Men-of-War and Their Embodiment in Design

By Rear Admiral W. L. Rodgers, U. S. N.

ABSTRACT

THE gist of this paper is to show the primary relations between offensive power, defensive power and time, resulting in three main types of ships of war. The destructive forces of warfare, like all other forces, need time for them to do a given amount of work. But the destructive forces of war can be overcome only by counter destructive forces. The passive elements of defense serve only to secure time for the attacking forces to do an appreciable amount of work. Passive defense alone may deny victory to the enemy, but only when it secures more time than the enemy has available to accomplish his necessary work. Passive defense never secures victory.

Upon these principles, naval architects lay down battleships to secure the very strongest combination they can design, having offensive strength as a force, with defensive strength to turn their attacking force into destructive work, and with mobility and speed (time element) to deny as much time as possible for the enemy's efforts to result in effective work. But to exercise these forces wisely we need "speed" ships to reconnoiter and direct our blow, and the same types of "speed" ships to screen and warn the main forces and gain time for them when attacked by the enemy and deny time to the enemy to attain his objectives. As against each other, these "speed" ships must have the means of attack to destroy each other and fight each other down in the pursuit of their objectives, i.e., information and security.

All the above are surface ships, the two other types, air craft and submarines, accept obvious weakness in attack to deny time to the enemy to meet their attack. Both types have permitted the natural law of gravity to be turned to their disadvantage in order to gain the advantage of surprise (time). Both are of moderate or small attacking force. The air craft seeks to deny time for the enemy's encounter attack to become effective by the speed of its approach and delivery of its attack. The reply to it is to be made chiefly by hostile aircraft, but also by gun fire from the ships attacked. In both cases, the weak air craft must itself be cautious and lose time, or run grave risk of destruction itself. For the type has sacrificed his powers of resistance.

The submarine, also weak in attack, by concealment denies the enemy the time for his counter attack. He must be reached by search, directed by listening devices and he must

be counter attacked by submarines and by auxiliary surface craft. Both air craft and submarines promise to be very valuable in reconnoitering over wide strategic areas (information service).

Thus the reply to the new weapons of the last war is largely through the counter application of the same types, namely air craft and submarines. But when a type is repelled by the same type of the enemy's, and these new weapons appear in their proper relations on both sides, they sink to the role of auxiliaries and leave the battleship as the final arbiter of battle, because when properly supported, the battleship has the maximum of strength—both offensive strength to punish the enemy and of endurance defensive strength to make its punitive power effective before it is overcome itself.

DISCUSSION

The discussion on Admiral Rodgers' paper was limited because of the reluctance of members of the society, in view of the Conference on the Limitation of Armaments, to express opinions which might in any way adversely influence the great work now being done in Washington. Captain W. C. Watts, U. S. N., pointed out that the inclusion of torpedo offense on battleships presented obstacles such as submerged torpedo tubes and interference with the proper subdivision of the vessels by watertight bulkheads.

American Classification of American Ships

By W. A. Dobson

ABSTRACT

THE classification of vessels is a matter of national importance from the fact that in vessels built to the rules of a classification society, the enormous risk due to inferior construction is eliminated. Classification, therefore, becomes a safeguard to life and property in vessels so constructed and only hazards common to sea service remain. Life and property so safeguarded become part of the nation's assets.

The object of any society for registration of vessels is to classify them in accordance with their strength and seaworthiness, with proper regard, on the one hand, to safety of life and property and, on the other, to obtain the necessary strength and seagoing qualities without impairing the earning power of the vessel.

Before the introduction of iron as a building material and the careful investigation of the laws governing floating bodies, vessels were built from prototypes whose characteristics were carefully noted and those meeting with approval were incorporated in following designs.

With the introduction of iron, stresses on ship structures in still water and in waves were investigated and scantlings under which vessels might be constructed and classed were promulgated, based upon scientific investigation combined with experience at sea with vessels of all types. Compliance with such rules insured that the resultant vessels would have strength of structure sufficient to meet all conditions of sea service.

Turning to a purely American registration society we find that in 1862 the American Shipmasters' Association was incorporated by an Act of the Legislature of the State of New York; the incorporators being men well known in shipping and maritime insurance.

This association continued to function under the original title until November, 1898, when, by order of the Supreme Court of the State of New York, the name was changed to that of the American Bureau of Shipping.

Due to the decline of American shipping and its reaction upon shipbuilding, from before the Civil War until the beginning of the World War, the activities of the American Bureau of Shipping were largely confined to American built coastwise vessels. The policy of the Bureau, however, did not seem to find full favor with steamship owners and foreign classification societies became so active in American shipbuilding that, prior to the Shipping Board assuming control of the building facilities of this country, about 96 percent of the United States seagoing vessels were built under the rules of foreign societies.

Advance in connection with American shipping developed very rapidly during the World War and Congressional action, taken in connection with vessels owned by the United States, made it absolutely necessary that there should be an American bureau of classification recognized as the authority for the proper classification of its vessels.

The Merchant Marine Act of 1920 provides that all departments, boards, bureaus and commissions of the Government should recognize the American Bureau of Shipping as their agency so long as that bureau continues to be maintained as an organization which has no capital stock and pays no dividends.

As the result of the reorganization and aggressive policies adopted, the growth of the Bureau may be seen by the following figures:

In 1916	gross	tonnage	classed	was	228,539	tons
1917	"	"	"	"	550,285	"
1918	"	"	"	"	535,232	"
1919	"	"	"	"	3,030,962	"
1920	"	"	"	"	1,918,007	"

It should be considered the patriotic duty of American shipowners, builders and underwriters to aid and encourage the Bureau in its efforts to build up an organization which, with its affiliations, shall be second to none in the world in the service rendered in classing, surveying, appraising, underwriting and salvaging vessels owned by the shipping interests of this country.

If we are to have a prosperous growing merchant marine, we must also have an American classification society, capable of rendering aid of the best class to every phase of the shipping industry.

DISCUSSION

Doctor H. C. Sadler, professor of naval architecture, University of Michigan, in commenting on Mr. Dobson's paper, stated that frequent criticisms had been made of the rules of the American Bureau of Shipping regarding lack of simplicity as compared with the rules of other classification societies. He stated that this point has been taken up.

Hugo P. Frear, naval architect, Bethlehem Shipbuilding Corporation, Ltd., called attention to the importance of saving weight in the scantlings and stated that the members of transverse framed ships were higher stressed than the longitudinal frame of the Isherwood type of construction. He noted that this point does not substantiate the claim that transverse framed ships may be constructed as light as the longitudinal type.

THURSDAY AFTERNOON SESSION

The joint meeting of the Society of Naval Architects and Marine Engineers and the American Institute of Electrical Engineers opened at 2:30 p. m. with Mr. McClellan, president of the electrical society, in the chair.

Electric Propulsion of Ships

By W. E. Thau

This paper is published in full on page 925 of this issue.

DISCUSSION

W. L. R. Emmet, consulting engineer of the General Electric Company, outlined the trials of the U. S. S. *Maryland,*

the latest naval vessel equipped with electric drive. He stated that he had been with the vessel for a week, during which time there was absolutely no trouble with the machinery and that newspaper reports to the contrary were without foundation.

Mr. Emmet felt that in certain respects this paper understated the practicability of electric propulsion equipment; that the system is distinctly more reliable than other forms of mechanical apparatus aboardship, since repairs can be made without the machinery necessary for turbine and reciprocating engine repairs. Other points which might be stressed in electric drive operation are its economy and savings in space and weight.

Special training is not needed for the engine room force in operating the machinery and in general the men are enthusiastic over the way an electric drive ship may be controlled. In speaking of low maintenance cost of the equipment, Mr. Emmet referred to the seven years' service of the U. S. collier *Jupiter,* which has cost practically nothing for repairs to machinery during that time.

Mr. Emmet outlined his reasons for thinking synchronous motors with their greater air gap than induction motors could be adaptable to propulsion units. If efficient turbines and auxiliaries are used, the excitation in starting synchronous motors can be accomplished with a low power consumption. Maintenance of these motors is comparatively simple since all parts and windings are accessible, due to the movable pole pieces. Simple solenoids are used for field windings and these are easily repaired.

Rear-Admiral W. L. Capps, U. S. N., Retiring President

In referring to the combination of the Diesel engine and electric units for propulsion, Mr. Emmet seemed to feel that high speed engines could be used without causing trouble from irregularity of flywheel effect.

Interchangeability of electric apparatus is also an advantage aboardship. The economy of this system was demonstrated on the trials of the *Maryland* when the ship ran at 19 knots on one generator and at 17 knots on one generator and two motors with two propellers trailing.

Another instance of this is the case of a merchant vessel designed for 22 knots which, running on one generator, made 18 knots. This speed, of course, would be the most economical for cruising. Larger gains are accomplished from pole changes at low speeds than are made at high speed.

Charles F. Bailey, engineering director, Newport News Shipbuilding & Dry Dock Company, compared the operation of turbine electric, Diesel electric, geared turbine and direct Diesel drives in single and twin screw vessels. This paper will appear later in MARINE ENGINEERING AND SHIPPING AGE as it contains numerous diagrams and tables that readers will find of value in determining the relative advantages of the different systems for special requirements.

William W. Smith, chief engineer, Federal Shipbuilding Company, discussed in detail points to which he took exception in the paper, citing results which he has obtained with various types of transmission machinery.

In referring to geared turbine drive he stated that he has found savings in steam consumption in favor of this type ranging from 4 to 8 percent and that superheat up to 200 degrees with additional savings is now being used in certain vessels having geared turbine drives. In his discussion of Diesel electric equipment Mr. Smith disagreed with the author's statements of space saved with this drive, claiming that Diesel installations occupy about the same space and weigh nearly twice as much as complete steam installations, including boilers. Cost per shaft horsepower for geared turbines using superheat is less than half that for twin screw Diesel electric propelling units, according to his records. Conditions of course would alter this statement.

In his discussion, an explanation is given of the backing and maneuvering power of compound reversing geared turbines which will develop 75 to 100 percent of the full ahead torque when required, as well as the effect of large slow speed wheels. In general, the backing power of steam driven compound geared turbines is ample for all requirements.

In referring to Diesel electric drive as compared with direct Diesel installations Mr. Smith seemed to think that the slower speeds of the latter tended towards greater reliability. Engine speeds of 250 to 350 revolutions per minute are not as conservative from the marine engineer's standpoint as 75 to 125 revolutions per minute. If high speeds are desirable because of weight and space saved, it would seem that mechanical gearing offers a better solution than the electrical system.

Electric drive machinery is a splendid engineering achievement and its mechanical operation is no doubt superior to mechanical gearing. The absence of mechanical difficulties and the smooth flexible operation appeal to the engineer. However, these features are not the chief ones in deciding the type of transmission to install in a vessel. The designer must be guided by comparative data and statistics as to first cost, weight, fuel consumption, cost of operation and the like.

Captain Q. B. Newman, chief engineer of the Coast Guard Service, outlined the experience of his department with electric drive, notably the installation of synchronous motor machinery in the cutter *Tampa.* When it was first proposed to electrify ships of the Coast Guard Service, engineers in the service did not know whether synchronous machinery would be adaptable for starting under heavy loads. To settle the question, the General Electric Company constructed a heavy set of 300 kilowatts capacity for experimental purposes. This set worked with entire satisfaction under test and when it was attempted to wreck the machinery it was found to be practically impossible. The only question remaining was whether in a heavy sea with the propeller out of water and racing the motors would still function properly. Up to the time of the meeting, the *Tampa* had not been out in heavy weather to determine whether the motors would be affected by loads coming on and off as the propeller was lifted clear of the water.

An important factor entering into the decision to install synchronous motors was that the lines of the *Tampa* are fine and would probably not carry the added weight of induction motors satisfactorily.

Fuel consumption aboard the *Tampa* up to the present has been erratic but complete data on her operation will later be available.

The Babcock & Wilcox boilers of 1,400 boiler horsepower installed in the *Tampa* were built for mine sweepers and

originally intended to supply steam to engines developing 1,300 shaft horsepower. Superheaters were added when the boilers were put into the *Tampa* and the steam generated at higher pressure with the result that the electric drive vessel developed 2,900 shaft horsepower.

In Coast Guard Service rapid maneuvering ability for inshore work is absolutely essential and the drive on the *Tampa* has given an excellent performance in this respect, being able to come to a dead stop from 15 knots speed within her own length and to be at full speed astern in 11 seconds. The response in backing and filling is practically instantaneous.

Elmer A. Sperry, president of the Sperry Gyroscope Company, seemed to feel that it is possible by the use of a new type magnetic air gap clutch to control Diesel engines at low speed, thus making unnecessary the combination of Diesel engines with electric drive. The origin of this clutch idea was in the work of Pomellio, an Italian aeronautical engineer, who developed an elastic link gear for coupling powerful high speed airplane motors to propellers. In this country a magnetic link was substituted for the mechanical elastic link of Pomellio, greatly decreasing the number of moving parts of his system and allowing simpler operation. The device constitutes a comparatively inexpensive gearing for reciprocating engines and takes care of fractional speeds of motors of the Diesel type which cannot operate at low speeds otherwise without drawing on the reserve supply of starting air.

Daniel H. Cox, Secretary

The air gap clutch drives by means of magnetic flux. There are four elements in the form of rings in the magnetic circuit, two of which are driving and two of which are driven. The flywheel proper accommodates an exciting coil producing the magnetic flux. At all fractional speeds or while this clutch is slipping, large currents are generated in the driven element by magnetic induction which act as short circuited secondaries producing heavy drag torques under perfect control by varying the amount of coil excitation. However, when the speed comes up in the vicinity of synchronism, locking occurs and the parts assume positions where enormous pull-out torques are present.

E. A. Stevens, Jr., stated that he considered that the only advantage of the various types of transmission—electric, mechanical gearing or hydraulic—is to run the main machinery at a different speed than the propeller. As the Diesel engine is more reliable as well as more economical at lower speeds it is better to connect direct to the propeller rather than to use any of the transmissions noted. For a slow speed ship of 3,000 horsepower or less the reciprocating engine has shown as good an economy as the average geared turbine and better than the electric drive.

Another thing to consider is the higher grade operators required to handle marine electric installations than is the case with electric locomotive or street car operation, since on board ship the staff must carry out practically all repairs.

Several examples of geared turbine as well as electric drive on naval vessels were cited where each has been found advantageous to fulfill certain special requirements.

Commander S. M. Robinson, U. S. N., felt that members of the society were already familiar with the results obtained with turbo-electric equipment and so in his discussion dealt mainly with Diesel electric propulsion.

By its use it should be possible greatly to increase the reliability of Diesel engines since it will not be necessary to start them up under load nor reverse them. With Diesel electric propulsion it would be possible to use multiple units, thus keeping down piston diameters, increasing reliability and reducing maintenance cost. For cargo vessels of the usual low horsepower it can be said that there will be little difference in the overall economy of the Diesel electric and the direct Diesel drive.

Commander Robinson seemed to feel that the voltage proposed in the paper was somewhat higher than should be used on board ship and that a 3-generator and 2-motor installation would give all the flexibility desired and obviate the necessity for using a high direct current voltage.

E. H. B. Anderson, of the Parsons Marine Steam Turbine Company, referred to the successful trip of the *Eclipse* around the world in which every part of her machinery worked well. However, he said that nothing was stated officially about fuel consumption on this voyage, but there have been rumors that it amounted to as high as 1.3 pounds per shaft horsepower per hour. The boilers were equipped with superheaters for 200 degrees. If this is correct, the showing is rather poor, since double reduction geared turbines would consume only about 0.59 pound of oil per shaft horsepower per hour. As a matter of fact the builders hardly gave this installation a fair chance for the propeller speed decided on was, in Mr. Anderson's opinion, not the most efficient. For an 11,000 or 12,000-ton freighter the most economical speed for the propeller is 75 to 80 revolutions per minute.

Mr. Anderson went on to describe alternative designs for machinery of the *New Mexico* and *Idaho* and the propeller speeds for these vessels. He stated that in high-powered vessels of 28,000 to 30,000 horsepower the use of multiple shafts and the propeller arrangement in direct and geared turbine drive were simply copied by the designers of electric installations, where special designs should have been made to give the greatest efficiency.

Weight, space and economy, in his opinion, were all in favor of mechanical geared machinery and until sufficient data on the operation of electrical machinery are available it is impossible properly to draw satisfactory conclusions.

Electric Auxiliaries on Merchant Ships

By E. D. Dickinson

This paper will be published in full in a later issue of MARINE ENGINEERING AND SHIPPING AGE.

DISCUSSION

F. C. Bates, of the General Electric Company, outlined his experience with the electric cargo handling machinery of the North German Lloyd passenger liner *Prince Heinrich* in 1895. This vessel was probably the first ever completely equipped with electric deck winches. For the first year or two that the ship was in commission, all kinds of trouble was experienced with the equipment, but after changes and adjustments were made in the machinery it was found to be satisfactory. In fact, the winches are functioning efficiently today with a record of twenty-seven years' service behind them.

G. H. Jett, president, Maritime Engineering and Sales Corporation, agreed in general with the conclusions of the paper dealing with electric auxiliaries and suggested that points to be borne in mind in deciding on equipment are the selection of motors of the proper type and capacity, with special attention to the waterproofing; that the control equipment for all electric motors and apparatus be limited to a minimum consistent with safety in operating devices being used, where practicable; that all protective devices limiting current to motors or equipment be installed in engine room compartments where they will be under the supervision of the engineering staff; that for all wiring not inclosed in conduits as far as practical armored cable should be used.

In the subject of rope speeds the items of greatest importance in selecting machinery are the acceleration and the speed of raising and lowering light hooks. In Mr. Jett's opinion 25 horsepower motors are ample for any cargo winch except in the case of lifts from very deep holds of the largest vessels.

In his opinion Mr. Dickinson has been entirely too conservative in his estimate of the possible economy of electric deck winches for steam equipment, both in the case of fuel for operation and repair costs.

Arthur Barker felt that on motorships electric auxiliaries will reach their widest usefulness and show the greatest reliability and economy. It is be regretted, he states, that we are compelled to refer to foreign-built ships for the principal performance information. Steam auxiliaries have proven to be a complete failure on motorships, a notable example being auxiliary equipment on the *California*.

Mr. Barker agreed with the author in that nothing but the most careful design and best materials and workmanship should be used, as the apparatus is exposed to all sorts of weather and is generally operated by unskilled men. Improvements can be made to equipment in this country by the addition of automatic control. The machinery of the *William Penn* is an excellent example of efficiency.

In connection with the steering gear it is questionable if a more satisfactory electric motor type has been developed than the hydro electric gear. This latter is ideal for control and makes a minimum demand on the generating plant with an efficiency equal to that of any other type.

Referring to the number of engine room auxiliaries and horsepower required, Mr. Barker believed that the following comparison should be given: steamship, 15 motors; motorship, 5 motors; steamship, aggregate horsepower, 160; motorship, 55; fuel consumption, steamship, 41 barrels; motorship, 25 barrels. It is essential that electrical apparatus should be enclosed, particularly rotating parts with commutators. Motors for below deck and engine room service should be inclosed except where size prohibits and then they should be open with protection against drip and condensation from pipes. Starters should be located as close to the motors as possible.

Electric auxiliaries have a place in the steamship when the generators are driven by engines or turbines. Electric auxiliaries only show a saving in the engine room when the generators are driven by oil engines. Adaptability of electric motors has been proven beyond question and the answer to what type ship shall carry the merchandise to the world is the motorship with electric auxiliaries.

Charles Rettie, of Liverpool, Eng., agreed that there is a large use for electric auxiliaries on board ships of the merchant marine and that there can be no question of the advantage of using electric auxiliaries for all power purposes except the actual driving of the ship. The best power for use on board ship is unquestionably direct current, but the tendency lately is to use submersible pumps which can only be run by alternating current. It will be necessary in up-to-date plants to have a rotary converter in the installation.

The number of circuits on a distributing system cannot be reduced with safety, since a large number of circuits must be run to supply the different parts of a ship with light and power. In this country at the present time the tendency is to use screwed conduits galvanized wherever possible in the electric lighting of our ships, and the conduits should be used for carrying wires and cables for auxiliaries.

Mr. McClellan outlined the British practice of auxiliary installations. He also referred to the fact that the British Navy favored the geared turbine rather than electric drive for capital ships and outlined the results with different type drives both in ships of the American and the British Navy.

In his trip across, Mr. McClellan came in a ship fitted with synchronous motor drive and, although the vessel encountered rough weather part of the voyage, no trouble was experienced with the motors when the propeller was out of the water and racing.

He suggested that in America sufficient progress has not been made in insulating the auxiliary machinery; that so far in his experience the only insulation that will successfully resist the action of salt water is mica and micanite, thoroughly baked. He stated that he was in favor of using direct current and two-wire rather than three-wire systems.

H. L. Hibbard, of the Cutler-Hammer Manufacturing Company, stated that the author might have been more specific in regard to certain points which he raised in his paper. For example, no mention is made where the dividing line comes between the types of electric steering gear now in use nor whether the hydro-electric gears for this apparatus have a distinct advantage. It seemed to be his opinion that the direct application of motor drive could be used to the best advantage in horsepowers up to 15 and the hydro electric at 20 horsepower and above. For severe service on deck winches the contactor control is specially suited. It is his opinion that, although safety devices should be omitted as far as possible, stalling devices at least must be furnished with anchor, windlasses, capstans, steering gears and overload contactors or circuit breakers with deck winches.

The advantages obtained from the use of electric drive to all auxiliaries on motorships are now apparent, as well as for deck auxiliaries on steam vessels. The question, however, of using electricity for auxiliaries in the engine room of steam vessels is more debatable.

At this point in the proceedings Mr. Thau replied to the points that were brought up in the discussion of his paper, stating that he would reply to each individual through the secretary and that these replies would be incorporated in the proceedings of the society.

William W. Smith, chief engineer of the Federal Shipbuilding Company, stated that he has found the cost of electric deck machinery to be considerably higher than steam machinery. As given in the paper, the steam consumption is about 50 percent higher than Mr. Smith has estimated for properly designed auxiliaries. Insurance cost for electrical machinery is higher than that of steam equipment and the savings mentioned in the paper would not be as great as estimated, although there is undoubtedly a substantial saving in fuel while in port and a minor saving at sea and possibly a slight saving in supplies, repairs and the like, but, when the higher first cost and other items are considered, the investment in such equipment, in Mr. Smith's opinion, would hardly pay. Steam deck machinery is without question inefficient, as there are large heat losses in pipes and the like. However, it is a great deal lighter and cheaper, and so far appears to have an advantage for steam cargo vessels. For motorships and passenger vessels, however, especially the former, electrical auxiliaries seem to be more suitable.

Rear-Admiral J. K. Robison, engineer-in-chief of the Navy, stated for the benefit of the society that on trial trips, naval vessels having electric drive machinery have given a

fuel consumption of 0.9 pound per shaft horsepower per hour between 10 and 21 knots; that the best performance on a trial trip ever made was with a geared turbine-engined destroyer which had a fuel consumption of 0.83 pound per shaft horsepower per hour and that the best electric drive record made was 0.86 pound per shaft horsepower per hour. The operating efficiency of the *North Dakota* has not been as satisfactory as expected, due probably to the lack of skill of the staff, which handicap will be overcome. The use of electric auxiliaries on the *Tennessee* has been greatly extended so that in port she has used less than 11 tons of fuel oil per day in driving her equipment.

Mr. Dickinson in reply to the discussion stated that he would refer in detail to the points brought out by the various members in the proceedings of the society.

FRIDAY MORNING SESSION

Admiral Capps opened the Friday morning session of the society at 10:30 A. M. No business came up for discussion so the reading of the papers scheduled for this session was commenced immediately.

How Can American Ships Compete Successfully With Foreign Ships?

By Winthrop L. Marvin

This paper is published in full on page 875 of this issue.

DISCUSSION

James Donald opened the discussion by giving operating statistics of American vessels and amplifying details brought out by Mr. Marvin and bearing out his statements as to the cost of keeping our ships in condition to compete successfully with foreign powers.

In this discussion the effect of employing foreign labor on American vessels was demonstrated.

Mr. Marvin replied to the statements in this discussion saying that the statistics presented would be of great service to the merchant marine. He referred to the conditions before the war when all sailors of the grade below the rank of licensed officers could be of any nationality. When the foreigners shipped in American vessels during this period they demanded the same rate of wages as American seamen and their work did not compare in efficiency with that of our own men.

He pointed out that during the month of October this year 97 percent of all men shipped on American vessels were American citizens, giving a higher proportion of unlicensed American seamen than ever before.

Mr. Marvin was very much in earnest in his statement that the merchant marine of this country could never expect support from Congress while it was manned by cheap foreign labor.

Mr. Donald declared that Mr. Marvin had given a scale of wages for American and foreign ships which even with the present exchange rates in favor of American currency showed that the operating schedules for ships of this country were higher than in any other. What the American merchant marine requires is more freedom in regard to the nationality of the crew and American shipowners should be allowed to employ cheap alien crews as other nations do. He then demonstrated on the screen the present commercial value of freight steamers of an average of 7,500 tons deadweight, giving the figure of $20 per ton deadweight. To bear out this figure he gave the chartering value for British and American steamers at the present time which indicated that to operate successfully the original cost could not be greater than the $20.

He also compared the cost of exporting coal in American and foreign steamers which indicates a loss to the American vessels of $1.82 per ton which completely eliminates our ships from this trade. In conclusion he stated that it is impossible at the present time for American steamers to compete with foreign steamers and that if it is necessary to adopt a subsidy for our ships it will mean an annual payment by the Government to overcome the extra wages on our vessels of a sum amounting to $31,680,000 per year. Conditions are very serious for obtaining new contracts for the shipyards and selling surplus steamers belonging to the Shipping Board and also the possibility exists of American shipowners controlling high price tonnage and chartering them at the present low freight rates, causing a heavy loss to the industry.

One thing that the Shipping Board should do is to determine a fair replacement value for tonnage and sell it at such a figure as will allow its economic operation.

H. C. Towle pointed out that in his experience the replacement value of vessels in at least one yard in this country is lower than it is in England, citing as examples a 10,000-ton tanker and a 9,000-ton freighter which were built in England at a price $6 to $8 a deadweight ton greater than in this country. It is essential after determining a fair replacement value to keep our ships operating in order firmly to establish our export trade.

The British are afraid of our dumping surplus tonnage on the market and their being bought by Norwegian and German operators.

W. H. MacKay, chief engineer, seemed to think that the great trouble with ship operation at the present was due to the existing seamen's laws which, while piling up the cost of maintaining a crew, cut down their efficiency. He stated that shipbuilders and designers by putting in a lot of superfluous fittings and luxuries for the men increased the building costs to too great an extent. He compared present conditions of seamen with those of the years when he first shipped in the engine room of a cargo vessel, pointing out that the waste today in materials by incompetent crews was greater than ever before.

Captain D. A. J. Sullivan, master of a successfully operating cargo vessel, declared that with an intelligent crew, proper support from the owners and control over repairs and maintenance there was no reason why American ships could not compete with foreign vessels. In his own case, the vessel which he now commands was bought during the period of high tonnage prices at $225 per deadweight ton. The ship is manned entirely with Americans and six of the eight officers are college men, seven of them having served during the war.

In two years, the operating cost has been reduced to a remarkable extent, fuel consumption being cut from 42 to 28 tons per day. At the same time the average speed was increased from 9.4 knots to 10.8. The entire wages of the crew, which is the highest type of any in American ships, is $2,300 per month less than on a Shipping Board vessel of the same size. Among other things, on this vessel a lot of the fancy equipment described by the previous speaker has been taken out of the vessel to prevent possible waste; for example, hand pumps were installed in place of the steam driven equipment and the original fresh water consumption of 162 tons for a voyage was cut to 14 tons.

The big items of expense, in his opinion, which make it impossible for American vessels to compete successfully with foreign ships are the cost of insurance, the cost of handling materials in transfer from the ship to other carriers, unnecessary detention in port, lack of personal contact between the owners' offices and the officers of the vessel and repair charges which are exorbitant.

Captain Sullivan stated that he had found it necessary, while his vessel has been undergoing repairs, to remain in constant supervision of the work so that it might be pushed rapidly.

The matter of turn around is also of the greatest import-

ance and he stated examples of the length of time taken to clear his vessel from port during different voyages, indicating that with close supervision of the work, the time might be cut considerably. During the war he had control of the operation of 300 colliers at Tyne and Cardiff, Wales, and during this period was able to gather operating statistics of great value and to determine the various factors entering into overhead cost.

The American shipping industry should not ask for protection against any extravagance of its own and, if American ships are manned by an intelligent crew and conscientious officers, the results in spite of higher wages are much better than if operated with foreign labor.

The Importance of Port Facilities in the Development of a Merchant Marine and Commerce

By Rear Admiral H. H. Rousseau, U. S. N.

Abstract

IT is an accepted traffic law, advanced by the late James J. Hill, that the volume of traffic a line can carry cannot exceed the capacity of its terminals. Unless and until our ports and port facilities are further developed and put on a thoroughly efficient operating basis, the growth of our merchant marine will be much retarded.

Delays in port mean lessened revenues and increased expense to ocean carriers. The increased cost due to unusual delays—which may in general vary from $1,000 to $5,000 per day per vessel—cannot be passed on to shippers, and has to be borne by the steamship companies themselves.

In our coastwise domestic commerce, the higher the cost of the operation of port facilities the more closely will the cost of water transportation approach the cost of transportation by land, and the greater will be the volume of traffic diverted from steamships to railroads.

The following may be given as some of the important characteristics that our ports and port facilities should possess from the standpoint of the interests of our merchant marine and our commerce:

1. The use of deep-water frontage should be restricted to the commercial business of the port.
2. At least half of the deep-water frontage should be publicly owned or controlled.
3. Berthing, handling, transferring, switching and storage facilities should be convenient, efficient and economical; they should be ample to carry any probable peak load.
4. There should be complete flexibility of movement between any and all water carriers and any and all land carriers, and *vice versa,* as well as from any water carrier to another.
5. The port charges should be reasonable; should be as similar as practicable, both in manner assessed and in amount, for all of our ports; and should be based upon actual cost of the service performed, including interest on investment and overhead. For ports under unified public control, the charges should be without profit.
6. All the facilities of the port should be under one control, which preferably should be independent of the local government. The port authority should be animated solely by the aim to conduct the port business as an efficient link in our sea-borne commerce and in thorough sympathy with our national policies for a merchant marine.

In an article such as this, it would be impossible to give a detailed description of port facilities. It is sufficient to say that the principal port facilities include necessary piers and wharves equipped with transit sheds, overhead cranes and other necessary handling devices. The distribution of freight to and from each wharf is attained by tying up the railroad terminal yards with each other and with the water front by the means of so-called outer belt line railroad. Communication between piers themselves should be attained by an inner belt line, which may be on land by railroad or on water by lighters, or by both. The port should be equipped with sufficient warehouse and storehouse facilities, for reservoir purposes, and to eliminate the uneconomical expedient of using freight cars as storehouses.

Discussion

Captain F. T. Chambers, C. E. C., U. S. N., emphasized several points brought out in this paper, first pointing out that the terminal is the bottle neck of the transportation system and as such must have sufficient capacity for the assemblage and classification of commodities and the piers should be properly designed to afford the quickest turn around for ships. All piers should be arranged for an adequate amount of railroad trackage, a 1,000 to 1,300-foot pier being at least 500 feet wide to permit tracks on each apron and down the center of the structure.

About two years ago the port facilities commission of the Shipping Board took up the subject of economies possible by a more rapid turn around and found that all charges for the vessel while in port, including depreciation, insurance, wharfage charge, port payroll, etc., amounted to $2,066.26 per day. It was felt that no record would have been broken, if the complete port turn around of the vessel in question had been 6 instead of the 15 days required, thus allowing a saving in expenses of $18,596.34.

Special type vessels for handling bulk cargo have been designed so that turn around can be accomplished in a few hours. The proper handling of miscellaneous cargo, however, is not so simple but proper design of our port terminals plus efficient operation and management will unquestionably produce excellent results and have a great bearing on decreasing the operating cost of our merchant marine.

William J. Wilgus declared that operators have not given the attention necessary to the matter of terminal facilities, expecting that someone else would look after the matter of efficient equipment. It is just as essential for the railroads to consider the terminal question as for ship operators since the pier or quay is a joint terminal at which land and water carriers meet for interchange. The neglect to plan and build the proper terminals, equipped with efficient apparatus, results in lengthened turn around for ships, the duplication of operations, the detention of rolling stock for the railroad and unnecessary delays for the motor truck.

He seemed to feel that the Federal government should take more active interest in the development of suitable connecting links between the land carriers and ships.

Unified management in the form of a port authority at each important seaport can effect important results in these developments, the authorities of London and Liverpool and of the port of New York being excellent examples of organizations which are operating successfully in the management of terminals.

Prompt and effective action and cooperation on the part of the Federal Government is absolutely essential to the stimulation of intelligent planning and creative work at every one of the gateways at which the nation as a whole has so much at stake.

Benjamin Thompson, president of the American Association of Port Authorities, declared that the administration of port facilities is too often placed in the hands of men who have had no training whatever in port affairs—matters which require careful and continued study and problems that demand close observation. Too often, efficient men in charge of port work are removed for political reasons and replaced by men who know nothing at all of the work. In his opinion the business and administration of a port should be conducted just as any other business involving the use of tremendous amounts of capital.

Congress in the enactment of the River and Harbor Act, March 2, 1919, and the passage of the Merchant Marine Act of 1920 has made a very important beginning of what it is hoped will eventually result in port administration throughout the country being placed upon a strict business and accountable footing. Information will soon be available on the port facilities of the country which has been prepared by the Bureau of Engineers under the chief of engineers of the United States Army. With this information available it will be possible to formulate conclusions as to some general form of port organization and administration that will be satisfactory.

Exporters and importers should be in close touch with those who administer port affairs. The American Association of Port Authorities is ready and willing to do its share in helping solve the problems that confront every port administration and invites all of them to join with the association in determining what is the best to be done that transportation by water, export and import commerce can be conducted most quickly and most economically.

Rear-Admiral F. R. Harris, U. S. N., outlined the necessity for improving our merchant marine with the idea of increasing our export and import trade. It is one of the important links in our transportation system and in order to build up a large foreign trade we must not only be able to manufacture cheaply but must also deliver our goods economically to compete with foreign purchasers. Freight charges, as is well known, are higher in American vessels than foreign, one of the principal features causing this being excessive terminal costs for handling material. Terminals should be improved not alone for rapidly and economically loading and unloading vessels but also in regard to the capacity of the terminal—that is, the number of vessels and cargoes unloaded simultaneously.

Admiral Harris referred to certain agreements between the railroads and foreign steamship companies, pointing out that we should be able to offer through rates in American vessels in competition with foreign vessels low enough to induce the railroads to cooperate with our ships.

The whole matter of foreign trade, merchant marine and port facilities is much involved but is a single problem and not three separate ones. We must be cautious and careful in our capital expenditures as regards productive plant, vessels, port works and terminals.

Charles E. Fowler, consulting engineer, stated that the seven postulates of the Montreal Harbor Commission, as given in their original report, cover the situation as to any important harbor most comprehensively. The first two are repeated here:

"The ports that are doing the biggest business and doing it most efficiently are the ports that have kept their facilities ahead of actual requirements.

"The ports that have remained stationary or lost prestige are those which neglected to provide facilities before business was forced to seek elsewhere the same facilities provided by rival terminals. Business follows the facilities."

From his experience with the Seattle Harbor Commission, Mr. Fowler sees no reason why the port authority should not be separated from any connection with municipal government—in other words, from politics. The port development plan in Seattle has worked out satisfactorily in every respect.

Any port will be a failure if the hinterland does not produce and consume material conducive to ocean commerce and this territory must have the necessary connecting or feeder railways. Railway and port facilities must cooperate in every way possible as is done in certain South American countries where for example the roof and doors of box cars are arranged to facilitate loading and unloading.

To reduce the overhead of ship operation such items as stevedoring, repairs, fuel and wages should all be made to show an improvement. We may rest assured that our merchant marine will not be a success until there has been a radical revision of our shipping laws.

The major problems of port location and arrangement of facilities together with the general design of harbors are ones which have not been given sufficient attention in the United States.

The task of forming a real merchant marine unit of our transportation out of such a heterogeneous mass of land carrying systems and port or harbor facilities is a tremendous one, but one worthy of the best minds among engineers, business men and statesmen.

Calculation of the Transverse Strength of Submarines by Marbec's Method

By Professor William Hovgaard

ABSTRACT

THE French naval constructor Marbec in 1905 contributed an essay on "Dilatation des Tuyautages" to Mémorial du Génie Maritime, in which he dealt with the strength of closed elastic rings of uniform section and of relatively small transverse dimensions by a method based on the fundamental work of M. Maurice Lévy. In Bulletin de l'Association Technique Maritime for 1908, in a paper entitled "Théorie de L'Equilibre d'une Lame Elastique," he developed the method further and applied it not only to a simple closed ring but also to arches. The method was for the first time, I believe, explained in English by Marbec himself in 1911, when he read a paper before the Institution of Naval Architects, "Notes on the Collapsing of Curved Beams and Curved Elastic Strips"; and in 1921 Mr. W. R. G. Whiting published the results of an application of the method to elliptical forms in a paper, "The Strength of Submarine Vessels," read before the same institution. In Germany Marbec's method was explained and applied to arches by Dr. Rudolph Mayer in Zeitschrift für Mathematik und Physik, 1913.

I shall endeavor to explain the method as briefly as possible, without following all the interesting side issues of M. Marbec, including only the steps necessary to an understanding of the method and its intelligent application to problems occurring in the design of closed frame rings, and more especially of frames in submarines, in cases where the resultant effective forces can be assumed to be equivalent to a uniform pressure all around the circumference. The proof here given is direct and simple and is essentially that given by Dr. Mayer. The method of application I have developed into a form which I believe is suitable for practical purposes and is exemplified in plates accompanying the paper.

Marbec's method is based ultimately on the same fundamental formula as that used in my work on "Structural Design of Warships" in the treatment of the closed frame ring.

$$d\theta = \frac{M}{EI}$$

The explanation of Marbec's method as given by Professor Hovgaard is of a highly technical nature and will form a valuable addition to the official proceedings of the society, where it will be published in full.

Cost Accounting and Estimating

By H. H. Schulze

This paper will be published in full in an early issue of MARINE ENGINEERING AND SHIPPING AGE.

DISCUSSION

Professor Sadler of the University of Michigan seemed to think that the value of this paper could be greatly increased if Mr. Schulze would make available the coefficients of cost and weight referred to. Such coefficients would be

useful as a basis on which to develop similar coefficients for estimating on practically any type vessel.

J. T. Dolcher stated that the chief function of the estimator is to work out as accurately as possible the actual cost of a proposed ship based entirely upon previous cost records obtained from the accounting department. Where such records are not available the estimate is based entirely upon previous experience.

Although the primary function of the accounting department is to furnish information to the management the fact should be emphasized that the more accurate the data turned over to the estimating department the more accurate and reliable the estimates will be. The general tendency of the accounting department has been to neglect this item in the past.

It is essential that the estimator be prepared to make a quick and reliable estimate based on information usually available in the form of specifications. A quick and reliable method of computing curves to cover the cost of various details such as piping systems and the like is essential. The efficiency of an estimating department is directly based on the amount and quality of information in the form of tables and curves on hand and the methods proposed to attain that end by Mr. Schulze are to be highly recommended.

T. M. Cornbrooks, New York Shipbuilding Corporation, stated that he had been impressed by the fact that no authentic attempt had been made until a few years ago to properly analyze costs and to work up factors which would be available for estimating purposes. The scheme which was formerly used was to analyze every ship which had been built both to determine the factor for estimating the material involved in a ship of similar design and for labor. Also to tabulate all standards such as side lights, deck scuttles, valves and the like so that estimates could be worked up quickly or the costs be entered per unit.

We analyzed the return costs of each ship as completed by first checking the materials charged on the drawings and orders and then from this analyzed the labor cost on the unit basis using an empirical formula for this purpose which was tested out on a number of different type ships before it was adopted as a standard. In analyzing the labor cost, we used both the hour and dollar cost as a unit, finding in ordinary times when the wages did not fluctuate that it was quicker to use the dollar unit and during an unstable period to use the hour unit.

By comparing the unit hour or dollar cost of various ships we were enabled to judge the efficiency of the various trades and the various contracts.

For the factors used in determining the coefficient for working out the hull steel weights we had our line man who worked on the marble slabs determine this as part of his job of laying down and fairing the lines so that our data were always up to the minute.

Too often the attitude of the accounting division is that the accounts should be kept in such shape as will satisfy their requirements only. To secure full advantage of the money spent in keeping costs they should be arranged so that the management can analyze them and determine the efficiency of the various departments as well as the various designs. In regard to comparing costs and data from different yards there is no standard subdivision of costs in use; for instance, some yards keep the steel hulls complete while others keep only the main structure in one item and lump the doors, hatches, etc., in with other miscellaneous fittings.

FRIDAY AFTERNOON SESSION

At the afternoon meeting Dr. W. F. Durand, honorary vice-president of the society, presided. The names of fourteen applicants for membership and three for associate membership were recommended for election by the council and were unanimously elected by the society.

Design and Construction of Passenger Steamers

By E. H. Rigg

This paper will be published in full in the January issue.

DISCUSSION

Dr. H. C. Sadler, professor of naval architecture, University of Michigan, pointed out that the size and speed of future vessels will be determined not by structural and power limitations but by the economic aspects of the service for which the vessels will be built. The mere question of size need not bother the naval architect today and we know enough about speed and power to predict results accurately under known conditions but details of passenger arrangements and the like will be studied more minutely than before so that it will not be necessary to go to extreme size for the desired capacity. In speaking of speed Dr. Sadler referred to the fact that we have a competitor for speed in the air ship, and questioned the advisability of attempting to strive for higher speeds in crossing the Atlantic by water.

Hugo P. Frear, naval architect, Bethlehem Shipbuilding Corporation, Ltd., remarked that this is an opportune time for the consideration of passenger steamers on account of the shortage of this particular class of tonnage as confirmed by the large number of inquiries for plans and prices for vessels of this type during the past two years. A considerable number of contracts would no doubt be consummated with little delay, if the purchaser was assured that present costs and rates would prevail for several years. Not only does this apply to passenger steamers but to many vessels suitable for special trades, some of which have been referred to in the paper. While it is true that the present high costs of construction and operation have put a damper on the building of floating palaces of the largest and fastest pre-war types, it is not understood that even vessels such as the *Mauretania, Aquitania, Imperator, Vaterland,* etc., were especially profitable before the war or compared favorably in return on the investment with intermediate types of the *Adriatic* or *Franconia* class. The largest and fastest pre-war types were the result of keen competition from an advertising point of view between Great Britain and Germany and also between steamship companies. The cost of advertising is now too great to indulge in on such a scale.

It is doubtful if the trend of design for intermediate steamers or passenger steamers for special trades is towards smaller dimensions or slower speeds. The average dimensions and speeds for the Pacific trade have certainly been materially increased and at least in one case for that trade, still larger and faster vessels are contemplated. Designs for new steamers, larger and faster than any previously employed, have recently been completed for not less than four different trade routes. Designs were also submitted not long ago for a steamer to cross the Atlantic in less than three days. This steamer, however, was not to cross at the widest part of the ocean.

In connection with the cost of high speed and fuel savings possible for high speed, moderate dimensioned vessels, it is not clear whether or not 760 feet is recommended as the limit of length up to 30 knots. The table on page 13 of the paper seems to indicate that 760 feet might not be the most desirable limit. This table also does not seem to offer convincing proof of fuel savings possible for high speed, moderate dimensioned vessels. The 600-footer may be considered a moderate dimensioned vessel but it is difficult to see from what point of view there is an economic saving in fuel as compared with the 1,000-foot vessel with a difference of only about 16 percent in shaft horsepower and something like a difference of 200 percent in displacement.

David Arnott, deputy chief surveyor, American Bureau of

Shipping, in commenting upon the particulars given of the 1,000-foot liner, stated that the comparatively narrow beam of 105 feet in association with a length of 1,000 feet and a depth of 76 feet is going back to the proportions of the Atlantic liners of a generation ago and does not appear to accord with the trend of later practice with regard to increased breadth. If 76 feet represents the depth to the uppermost complete deck, he continued, it would be interesting to know how many tiers of deck houses were to be superimposed on this deck. In a 1,000-foot ship designed to travel at a speed of 30 knots, the panting arrangements at the ends and the anchoring of the large deck houses would require to be given very careful and special consideration if trouble is to be avoided in these particular neighborhoods. Mr. Arnott also took issue with Mr. Rigg as to the effect on the weight of increasing the breadth and fining down the ends in a vessel of the same length and depth and suggested that the increase in weight over the corresponding vessel of normal proportions and block coefficient would be quite considerable in cases where the scantlings are required to be taken direct from the tables in association with a system of numerals. Referring to standardization Mr. Arnott pointed out that the new British standard sections provide British shipbuilders with a much more economical range of shapes, especially bulb angles and channels, than we have available for shipbuilding in America. As the adoption of a single line of up-to-date channel sections for all structural purposes in this country would be advantageous for both shipbuilders and structural engineers, he hoped that our steel manufacturers can be persuaded that this course will also be in their own interests. Other aspects of standardization in foreign countries with regard to shipbuilding and engineering, such as Scotch boilers, marine reciprocating engines, ship fittings, etc., received favorable comment and it was suggested that the matter is worthy of the very earnest consideration of American shipbuilders and engineers. Mr. Arnott was pleased to have Mr. Rigg's opinion that the recent revision of the rules of the classification societies has placed in the hands of the shipyards methods of designing structure and details which enable much quicker and better work to be done.

W. W. Smith, chief engineer, Federal Shipbuilding Company, in referring to the author's statement that electric drive was first contemplated for the 1,000-foot liners, stated that from his investigation he would estimate roughly that the weight and cost of the electric drive machinery would be from 70 to 80 percent more than the geared turbine propelling units, and that the steam consumption would be from 4 to 8 percent greater. The latter would also reduce the weight of boilers, auxiliaries and fuel to a slightly lesser extent. He emphasized especially the large economic advantages of geared turbines and high superheat. If we compared a geared turbine installation using steam superheated to 200 degrees with a well designed triple expansion engine installation using saturated steam, it will show that the weight and cost of the engine installation will be about 80 percent more than the turbine installation, and that the saving in fuel consumption of the latter will be about 30 percent. With geared turbines and high superheat, a fuel consumption of 0.85 to 0.90 pound per shaft horsepower should be obtained for installations up to about 30,000 shaft horsepower and above this, from 0.80 to 0.85 pound should be obtained. Mr. Smith concurred in Mr. Rigg's views on standardization and thought that large economies could be effected by efficient standardization in machinery and detail parts.

Walter M. McFarland, manager marine department, Babcock & Wilcox Company, and president-elect of the society, called attention to the increasing use of watertube boilers in passenger liners and the savings in weight of machinery and other economies that are possible from this source.

Commander T. Kawahigashi, of the Japanese Navy, in a written discussion read by Lieutenant-Commander Sasai, I. J. N., expressed satisfaction that a large number of the ships of the *American Legion* type are destined for Pacific service, where they will undoubtedly play an important part in increasing the trade and consequently the friendship between the United States and Japan, and in bringing these two countries closer together by an ever decreasing distance. In speaking of experiments with model propellers he pointed out how fortunate we are in this country to be given the benefit of the experiments carried on by the Navy; where the Navy is willing to share the results of what is done experimentally with private shipbuilders, the art of naval construction is bound to make rapid progress. The recent tendency to decrease the length of passenger ships he believed to be only a temporary phenomenon of post-war reduction and prophesied that it will soon return to the pre-war condition. Mr. Rigg's opinion regarding the advisability of increasing the breadth of a ship he pointed out as another indication of how we are profiting by the lessons learned in the great war. By increasing the breadth beyond the proportion usually accepted, greater stability is secured and the life of the ship is safer. Commander Kawahigashi gave details of the electrically propelled tanker which is being built by the New York Shipbuilding Corporation for the Japanese Navy, and stated that undoubtedly electrically propelled ships are going to play an important part in future naval construction and it is gratifying to know that the Japanese Navy is getting its first lesson in this development from the United States.

E. H. B. Anderson, of the Parsons Marine Steam Turbine Company, expressed the hope that a second paper on the Design and Construction of Passenger Steamers would be presented before the society at a later meeting which would deal more fully with the machinery for the class of ships described by Mr. Rigg.

Elmer A. Sperry, president, Sperry Gyroscope Company, predicted that Diesel engines are going to propel our ships in place of steam machinery. He said that the development of 12,000 horsepower in 6-cylinder Diesel engines is now in sight.

Written discussion was also submitted by H. F. Norton, naval architect, Newport News Shipbuilding and Dry Dock Company, and C. E. Petersen, naval architect, United States Lines, but not read on account of lack of time.

The Influence of Shape of Transverse Sections Upon Resistance

By Professor H. C. Sadler and Professor E. M. Bragg

This paper will be published in full in a later issue of Marine Engineering and Shipping Age.

Discussion

Several speakers, including Professor L. B. Chapman, of Lehigh University, Hugo P. Frear, naval architect, Bethlehem Shipbuilding Corporation, Ltd., and E. H. Rigg, naval architect, New York Shipbuilding Corporation, expressed their appreciation of the authors' work in presenting this very valuable paper to the society, but stressed the point that some standard method of presenting such results would be highly desirable.

A. J. C. Robertson, naval architect, Munson Steamship Line, complimented the authors upon the value of their work in this paper and went on to say that a good model freight ship has been used as a starting point and that model has been varied radically in the shape of the transverse sections in the fore and after bodies and in addition the lengths of these bodies are rearranged to the whole ship length; and

all the models have been tested at four different drafts, and the results furnished except in one case.

The first set of results, from a full form of long run and a fine form with equal entrance and run, shows each with two kinds of stern and one bow, and also with two kinds of bow and one stern. The variation of the stern lines shows, in general, very small change in the resistance values but in general the U-shaped stern with the consequent narrower water lines shows up somewhat better. This permits shipbuilders to indulge in a reasonable amount of club foot of the stern lines, permitting more rigid support to the propeller shaft and somewhat easier lines above water, preventing the slamming which occurs with a full counter when the vessel is making its way against a head sea.

The variation in form is much more interesting where the bow is changed and in general the results also help the naval architect because with the fuller model the V-shaped bow shows up considerably better than the U-shaped bow for the useful range of speeds; whereas in the fine model the U-shaped bow is the best. This apparently indicates that a certain amount of fullness is desirable near the base line irrespective of the fullness of the waterline, but that excessive fullness, which is fatal to the ship's structure in head seas, is also bad for the ship's propulsion.

The results from a single model shown at four different drafts throw a great deal of light upon the problem of U- and V-shaped lines. Quite apparently the variation in the bow sections is the more important one, and considerable savings in power can be gained by the adoption of the correct transverse form. At very large drafts the difference between the V bow and the M bow is very much less than for the lesser drafts,—this curious feature is in accordance with the observation I have made in analyzing other models. A fullness of transverse section in the underbody affects the resistance in proportion to its nearness to the load waterline. It is customary to think of the residuary resistance of ships as wave-and-eddy-making, and though we have no means of measuring the relative amounts of these resistances, this practice is a good one. That part of the ship which is sufficiently far under the surface has relatively little to do with the development of the diverging waves, which are always lost, and the transverse waves, which may be lost or may be, in a large measure, recovered according to the length of the parallel bodies adopted. If the lines low down are shaped for eddy-making only, the result will be good providing the draft of the ship is sufficient, but at the lighter drafts wave-making is set up and interferes with the normal resistance of the ship.

In Mr. Robertson's opinion Figs. 6, 7, 8 and 9 will probably be considered the most valuable part of this very valuable contribution. They represent an enormous amount of work and provide the greatest assistance to the designers of full form ships, as they enable the designer at once to select the fullness of model satisfactory for any given speed at any given draft and provide him with resistance figures corresponding to the model. As for Figs. 4 and 5, the prismatic coefficient varies throughout this series and therefore the resistance curves are composite ones representing an optimum model with constantly varying fullness to suit its particular speed.

Mr. Robertson criticized the authors' method of presenting the tank tests on the ground that the conversion of the results of this paper to any other standard method of presentation is going to be quite a serious matter. He also believed that the resistances should have been presented for a standard vessel 400 feet long, as in other papers, and that they should have been reduced to a constant temperature of 70 degrees, as used at the Washington tank. The most serious criticism of the whole paper in his mind, however, had to do with the actual quantitative results themselves. These are expressed as EHP upon displacement, divided by the cube of the speed ratio. This system, which is quite novel and therefore useless for comparison purposes with any previous results, he contended, is also without the one advantage claimed for it, that it is suitable for ready application by the busy naval architect who does not specialize on ship resistances. This form of expression gives serious differences for very limited changes in draft and is impossible of application for any important changes in length, and therefore the data presented is very limited in its application; even a 12 percent variation in length above or below that at which the results are given shows 1 percent variation in resistance and other drafts than those presented could only be obtained by the use of cross curves. The advantage of experimental tank results is largely that it enables a designer to choose the minimum dimensions of a vessel for a given duty and that the economies so effected are usually greater than the economies gained by a slight variation in the resistances of a vessel of fixed size. Any investigation along the lines of variation of ships' dimensions must be carried out on a different basis than that on which these results are presented. Anyone who has had any experience with the Froude "C" Constant System will realize how very much superior it is to the one here used.

Power and Speed Trials of Ten Thousand Deadweight-Ton Tanker

By H. A. Everett

This paper will be published in full in an early issue of Marine Engineering and Shipping Age.

Discussion

Professor E. M. Bragg, of the University of Michigan, declared that the data contained in Professor Everett's paper were extremely valuable, especially for those interested in propeller work. Information on the wake of the vessel is all that is lacking to make the test complete. It so happens, however, that the results of towing current meters after a model of the tanker at the University tank to determine the characteristics of the wake are available and will amplify the tests so they can be used for almost any purpose of comparison in getting out new designs. The paper also gives an excellent outline of engine performance, but it would be helpful if the clearances at the top and bottom of the cylinders and the designed cut-offs were given.

Model tests are run on a length to breadth ratio and if data on the lines were given in the case of a test, the results could be used to better advantage—that is, whether the sections were U- or V-shaped in any particular model.

E. H. Rigg, of the New York Shipbuilding Company, stated that this paper was the most complete record of the actual performance of a ship as compared with her model tests that has ever been prepared in this country. He added that test runs should be made in sets of three to eliminate type variations. This was done with the tanker described in the paper. Results of tests to determine the effect of the wind are now being analyzed by the New York Shipbuilding Company and will be contributed to the proceedings of the society within a short time.

Rear-Admiral D. W. Taylor, U. S. N., chief constructor of the Navy, in a written communication, stated that he was interested in the method adopted for running trials. The corrections for wind effect constitute a new departure in this work. By dealing, as the author does, with curves of mean effective pressure plotted as revolutions, the wind effect can be reasonably well eliminated. Also, if the slip is assumed to be constant, the method used for correcting the speed curves for wind effect will be quite close to actual conditions.

The efficiency of propulsion deduced by Professor Everett would be slightly higher if the actual effective horsepower for the trial displacement had been used.

Another factor never before subjected to analysis is the effect of the rudder. When the rudder is put over, it constitutes a powerful brake and there is a material difference between the speed and power curve with a good helmsman and with a poor helmsman. Data on this subject from members of the society would be of great value.

American Shipyard Apprenticeships, Evening Schools and Scholarships

By Charles F. Bailey

ABSTRACT

APPRENTICESHIP in shipbuilding is generally in vogue in the older established shipyards of this country. Some yards have had apprentice courses for many years, but only within the later years has there been any considerable interest in the matter, and even at this time there is an opportunity for advances which would be of benefit to both the apprentices and the yards.

At present the various yard apprenticeship regulations are quite similar and include a considerable course of study, in most cases as a part of the system; in some yards independent evening schools are maintained for the benefit of the apprentices and other employees, both male and female.

A movement is now under way to offer, as an incentive to apprentices, short scholarships in higher institutions of learning, which may be won by competition.

Trades in which apprenticeships are offered are as follows: anglesmith, blacksmith, boiler maker, coppersmith, draftsman (construction), draftsman (engineering), draftsman (hull), electrician, joiner, machinist, machinist (steam engineering), molder, pattern maker, plumber, sailmaker, sheet metal worker, ship carpenter (including shipwright work, boat building and spar making), ship fitter (including mold loft work), ship rigger, welder (electric and acetylene worker).

The length of course is usually designated as four years, sometimes of a certain number of hours per year. A number of companies have provisions for credits by which the length of the course may be reduced to a minimum of three years by reason of special proficiency and all-round excellence.

Qualifications necessary for training are stated by various yards thus: average alertness, a good grammar school education, ability to read and write, familiarity with arithmetical processes, satisfactory personal presence, of such stature as to fit them for the trade selected, each candidate required to pass a physical examination by the company's surgeon before entering the apprenticeship and a similar examination annually thereafter during the apprenticeship.

No definite rule has been generally adopted as to the number of apprentices in the various shipyard trades. This is largely accounted for by the uncertainty of the work whereby the number of employees has varied greatly due to trade conditions and requirements for naval and merchant work. In slack times it is best to retain as many apprentices as possible, only weeding out those least desirable.

Supervision is handled by various methods. In one yard a supervisor of apprentices has general oversight of all the apprentices throughout the yard and is the principal of the school work; under him are several instructors. In the shops apprentices are instructed by mechanics who especially look after a number of boys, assign them work and instruct them in the correct method of performing the work, operating the tools, etc. Promotion is based on the rating from monthly reports from the various shops and for school work. In some cases the shop work counts double that in the school.

Pay of apprentices varies in the different yards, ranging, as compared with first-class journeyman wages, from about 30 percent for the first six months to 80 or 90 percent for the last six months. It is usual to increase the pay on the completion of each six-month period so that for a four-year course there are eight grades. At some yards the pay ratio is higher at the beginning and less at completion than given above.

At the end of the apprenticeship course it is usual to provide a bonus, varying from $50 to $100, for satisfactory completion. In some cases where the apprentice is obliged to leave before the completion of this time, otherwise than due to neglect of duty, disobedience of rules or other improper conduct, the apprentice is paid such portion of this sum as the time served bears to the total term of apprenticeship.

In addition to the apprenticeship schools some yards in conjunction with the industrial Y. M. C. A. of the community or with other organized bodies or vocational schools, conduct evening classes to which the apprentice boys may or may not be eligible. These classes are not usually self-supporting. They should have the highest grade of talent in the director and in the teachers; and frequently this is easily obtained in large yards by drawing on the trained, technical college graduates, who are willing to give their time for a reasonable remuneration. Such schools are largely attended by workmen and young women, and some of the apprentices also take advantage of them for advanced work and for fitting for college.

SCHOLARSHIPS

Some employees welcome an opportunity for advancement dependent upon their individual efforts and competition. In line with this it is suggested that large shipbuilding companies give consideration to the establishment of a small number of scholarships as follows:

(a) A four-year course covering work in language, mathematics, physics, chemistry, metallurgy, electricity, marine engineering, naval architecture or allied subjects in an approved university, technical school or institute, granting the degree of bachelor of science.

(b) A two-year course covering similar work in several of the above subjects in an approved university, technical school or institute.

(c) A one-year course covering similar work in several of the above subjects in an approved university, technical school or institute.

(d) A home correspondence school course in an approved correspondence school or a course of thirty-six weeks in the industrial Y. M. C. A. evening preparatory school of the city.

Examinations for these scholarships to be held at suitable intervals.

With companies employing several thousand men it should be the aim to recruit both their technical staffs and managerial staffs as largely as possible from their own employees. The establishment of scholarships (b), (c) and (d), as outlined above, has been authorized by one large American shipbuilding company and the details of this work are being developed with the intention of announcing these scholarships so that a few of them may be competed for and granted within the next year.

In solving this problem of supplying our shipyards with men possessing manual skill, as well as technical and theoretical ability and knowledge, it is well not to overlook home talent, familiar with the work of the home yards and whose ties are largely there. Such young men are in line for more valuable service to the company than those who are only highly technically educated or manually skilled or without the community ties. The combination of these qualifications is a step in the direction of efficiency and progress.

A novelty in apprentice training has been introduced by the General Electric Company at Lynn, known as the cooperative course at the Massachusetts Institute of Technology. By the cooperative plan the apprentice alternates three months with the Institute of Technology and three months in the apprentice shops. This course has been arranged to

cover a period of two years. A similar arrangement is in vogue with the Westinghouse Company and a leading university, and I understand some of the locomotive companies have also followed such a procedure with success.

This matter of apprentice training and education is one of great human interest and, if properly accepted by the shipbuilding companies, it is certain to strengthen the morale, reduce the turn-over and benefit both employers and employees. It should not be looked upon as social work but as a business proposition. Many large organizations now see that business with service is most desirable; here will be found a field for both.

Discussion

E. H. Peabody declared that the shipbuilder was not altogether altruistic in planning for the education of young men to carry on the industry in the future. Education should be systematic above everything else and the best method in his opinion is a combination of technical with practical training in the shops. Teaching is a fine art and men who work part of the time in the shops cannot achieve the results in teaching young men that instructors devoting all their time to the work are able to do.

Spencer Miller suggested the need of a closer cooperation between technical schools and our industrial establishments. The details of Mr. Bailey's scholarship classifications (a), (b), (c) and (d) provide a systematic way in which the varying demands of the apprentice group may be wisely met.

Professor H. A. Everett outlined the plan carried out by the Union Shipbuilding Company of taking young men soon after graduating from technical schools and putting them through a two years' course of training in all parts of the organization and then using those able to qualify in minor executive positions and the like. A closer relation between technical institutions and industries should be fostered. The colleges will always be found ready to cooperate in any way possible.

Benjamin G. Fernald seemed to think that the technical college had brought about a condition which was not for the ultimate good of industry, by dividing the man power into groups, one for the actual work, and the other to superintend and carry on the executive details—the latter being college trained men without practical experience.

Mr. Fernald was quite in sympathy with the plan referred to in the paper, the only suggestion offered being that those putting the plan into effect guard against losing sight of the fundamental purpose, that of making competent workmen. The educational features are in the nature of a reward for effort on the part of the apprentice beyond that merely necessary to secure his certificate. With such a system little if any preference should be shown to technical graduates.

Professor L. B. Chapman, speaking on behalf of the universities, declared that the colleges were only too glad to cooperate with the industries in training men. The finest types of young men who come to the technical schools for education are those who have had practical experience in an industry and have a definite desire to study with the object of returning to that industry.

At Lehigh University the present senior class in naval architecture has had at least eight weeks training in shipyards and eight weeks at sea. This combination of experience is the best foundation for the training of these men in the art of shipbuilding.

H. P. Frear agreed with the method of training apprentices and establishing scholarships as outlined in Mr. Bailey's paper.

W. W. Smith also agreed with the points taken up in the paper and seemed to think that the training of personnel should be an official responsibility and function of every company.

H. C. Towle felt that students should be made to look upon their college training as a background on which to develop their positions in industry.

C. T. Coler declared that we are not awakening to the need of industrial education any too soon. Work should be the backbone of such training and should be dignified in the school, in the home and in the industry. He outlined the experience of the Westinghouse Electric & Manufacturing Company, which has been successful in training apprentices and technical men.

The future progress in industrial training lies in a quality rather than a quantity standard—fewer men, better trained.

Maxwell W. Day, in outlining the methods used by the General Electric Company, stated that this company does not attempt to maintain a definite ratio of apprentices to journeymen in any trade. At all the large plants of the company well equipped apprentice training rooms are maintained, where young men begin their work under the supervision of qualified instructors.

Mr. Day approved of the scholarship feature of Mr. Bailey's plan.

In addition to the apprentice course, the General Electric Company has a student engineering course for graduates of technical schools selected by a representative of the company who visits the various technical colleges each year.

L. C. Brooks explained the system of cooperation existing between the Lynn shops of the General Electric Company and the Massachusetts Institute of Technology. A great field for similar arrangements is open between educational institutions and the industries.

Walter M. McFarland pointed out that it was not advisable to make higher education too easy, that it must be worked hard for to be of real value. As has been stated by one famous educator, higher education too lightly considered has spoiled a great many good mechanics and clerks by making poor engineers and business men.

He also outlined the system of entrance to Webb Academy and offered the facilities of this institution to the sons of men in the various shipyards who showed special interest and aptitude in shipbuilding.

John H. McAlpine outlined the early systems of training apprentices in Great Britain. The opening of schools in the works as is now common in this country was a great advance. These works schools are not intended to replace institutions of higher learning and could not possibly do so.

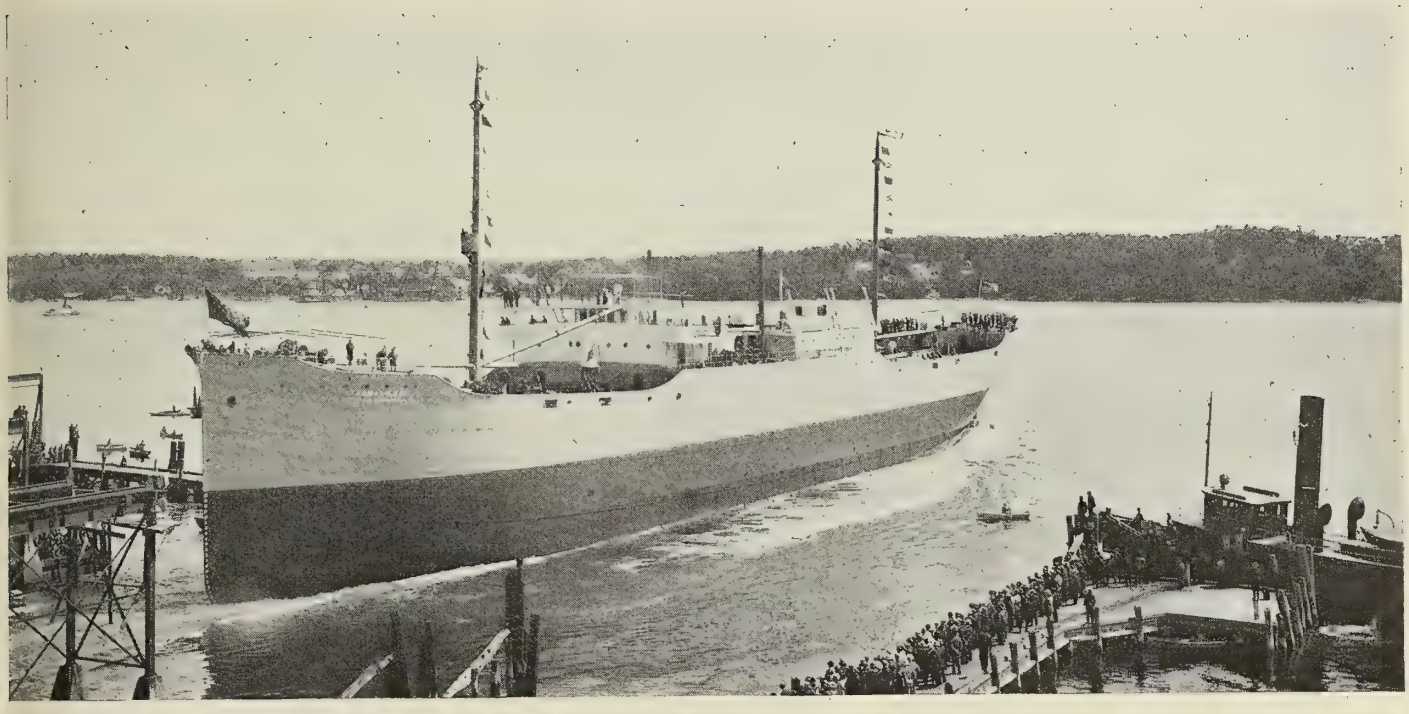
Cooperative plans of training are excellent as typified by the arrangement between the Massachusetts Institute of Technology and the General Electric Company at Lynn. This system is similar to the Cincinnati plan originated fifteen years ago, in which "every student of the University during his course is required to work four terms of three months each in some of the engineering industries of the Pittsburgh district." While in the works the students are kept under the observation of their professors.

William L. Cathcart seemed to think that the system suggested by Mr. Bailey would attract a fine class of young men to the industry.

Peabody-Fisher Oil Burners

THE Peabody Engineering Corporation, New York, demonstrated a new wide range mechanical fuel oil burner at the Exposition. By means of this burner the steam pressure in a vessel's boilers can be controlled by regulating the amount of oil atomized by the burners. This burner delivers oil at a high centrifugal speed through a tip orifice on the general principle of other mechanical atomizers and it also has a return feature of atomizing any quantity of oil from its designed capacity to 12 percent of this amount.

Diffusers made of a special heat resisting alloy are fitted to each burner instead of the old type of cast iron diffusers.

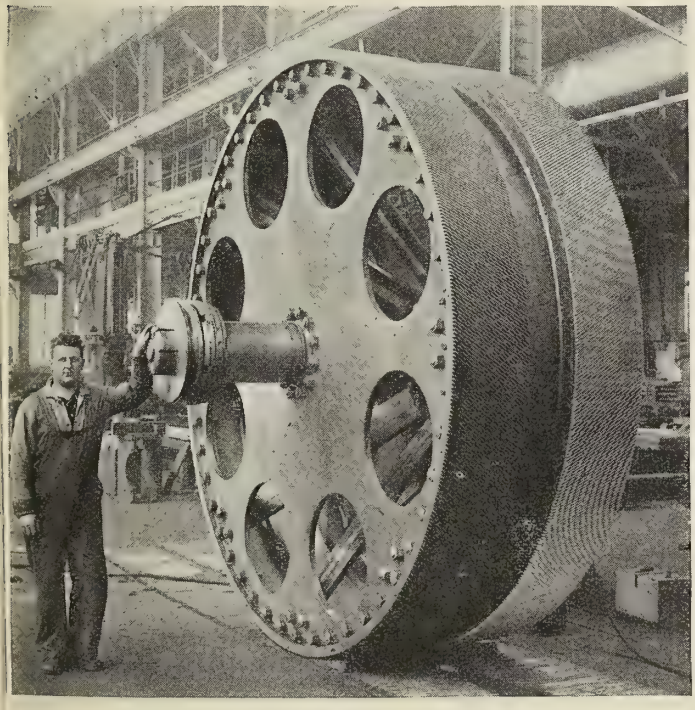


Launching of S. S. Thomas P. Beal at the Bath Iron Works

Modern Steam-Driven Freighter Thomas P. Beal

9,600 Deadweight Ton Vessel Designed for General Freight Service, Propelled Through Single Reduction Gears by Parsons Turbines

ONE of the most persistent criticisms of the large fleet of merchant vessels constructed by the Government during the war has been that the vessels were built primarily for war needs and were not of a type suitable for economical operation in normal peace times. That this criticism is taken seriously in some quarters is evidenced by the fact that while approximately 1,000 Shipping Board vessels are lying idle the construction of a number of new merchant ships is being carried on throughout the nation. The *Thomas P. Beal,* which has just been completed at the plant of the Bath Iron Works, Ltd., Bath, Me., for the Crowell & Thurlow Steamship Company, Boston, Mass., represents a modern post-war type of vessel for general freight service.



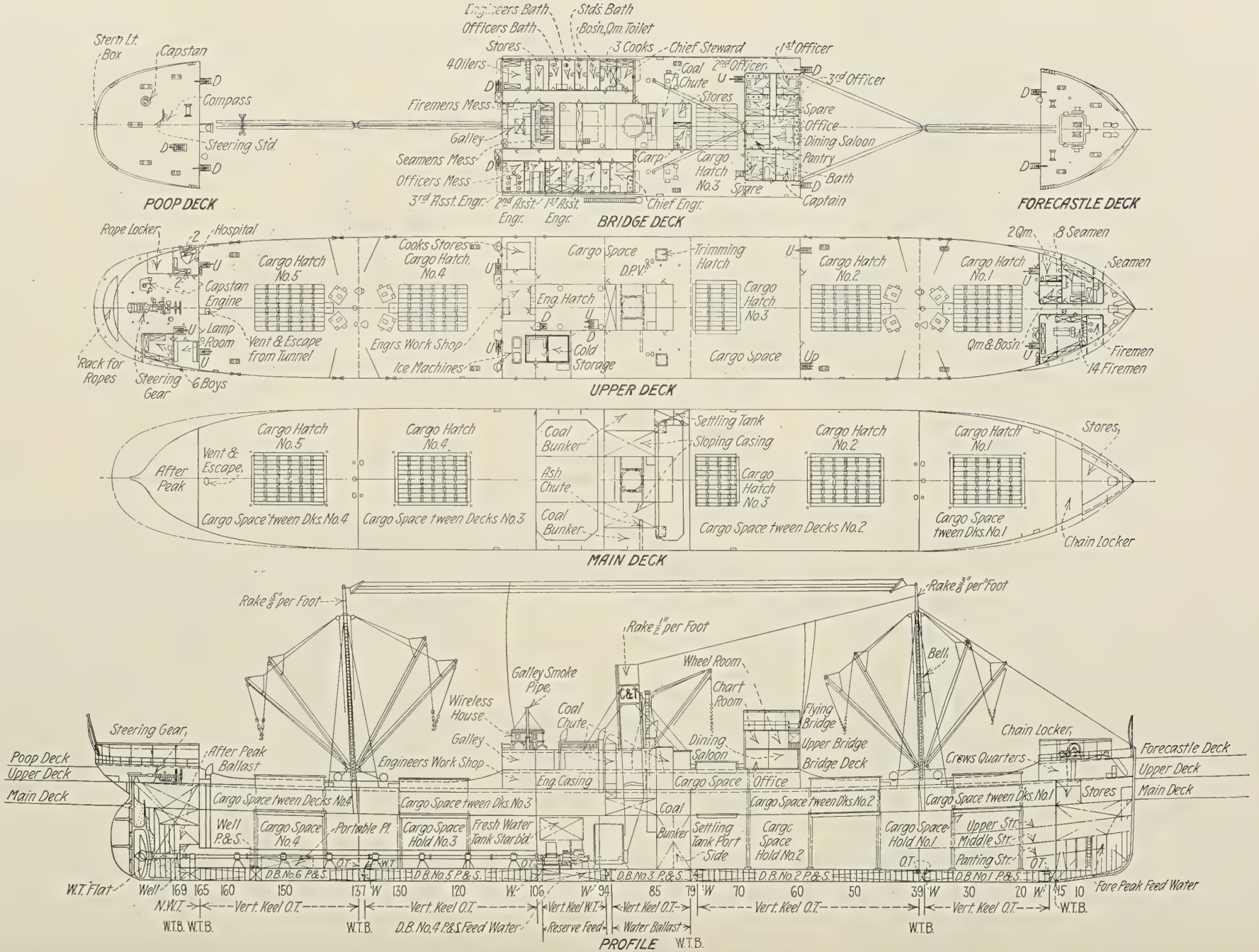
Main Gear Wheel Ready for Installation

This latest addition to the Crowell & Thurlow Steamship Company's fleet is 395 feet 6 inches long between perpendiculars, 55 feet beam and 34 feet 6 inches molded depth. It is in general a sister ship of the *A. L. Kent,* built by the same company last year for Messrs. Crowell & Thurlow, except that its main propelling machinery consists of geared steam turbines instead of reciprocating engines as in the *Kent.* This change has enabled the machinery space to be shortened one frame space, while still obtaining the maximum tonnage deduction for propelling machinery, and in this way the cubic capacity has been increased by 3,250 cubic feet. It has also been found possible to increase the deadweight tonnage approximately 50 tons so that this vessel represents a considerable advance over its sister ship. The fuel consumption also has been decreased as compared with the *Kent* by the use of geared turbine machinery.

Hull

The *Thomas P. Beal* is a vessel of the poop, bridge and forecastle type with machinery amidships and one funnel and two pole masts. It was built under special survey of the American Bureau of Shipping to class ✠A.1. E, the construction and equipment being also in accordance with the rules of the United States Steamboat Inspection Service.

The vessel is built on the transverse framing system with a straight stem and semi-elliptical stern and has a short poop 40 feet long, a bridge 116 feet long extending over the engine



S. S. Thomas P. Beal: Profile and Deck Plans

Modern Steam-Driven Freighter Thomas P. Beal

General Information

Service: General Freight.

Builder: Bath Iron Works, Ltd., Bath, Maine.

Owner: Crowell & Thurlow Steamship Co., Inc., Boston, Mass.

Characteristics

Length, overall	410′ 6″
Length, B. P.	395′ 6″
Breadth, molded	55′ 0″
Depth, molded	34′ 6″
Draft, loaded	27′ 1″
Draft, light	8′ 4″
Block coefficient	0.78
Midship section coefficient	0.99
Longitudinal coefficient	0.79
Speed, loaded, knots	10
Cruising radius, nautical miles	11,000 (oil)
Framing	transverse

Class ✠ A-1E American Bureau of Shipping.

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull	3,048
**Weight Propelling Machinery	465
Deadweight Capacity	9,600
Displacement	13,113

(In tons of 100 cubic feet)

Gross register	6,216
Net register	4,509

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.

**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez		
Panama		

Equipment

2 Bower anchors, stockless, each	7,140 lbs.
1 Bower anchor, stockless	6,104 lbs.
1 Stream anchor, ex-stock	2,450 lbs.
1 Kedge anchor, ex-stock	1,050 lbs.
Chain, cable, 2¼″ stud	270 fms.
Towline, 4½″ circ. steel wire	120 fms.
Streamline, 4¼″ circ. steel wire	90 fms.
Hawser, 8″ circ. manila	180 fms.
Hawser, 7″ circ. manila	180 fms.

Rudder

Area, square feet	157
Dia. Stock, inches	10.5
C. Press, abaft C. L. pintles	3′ 3″

Complement

Deck officers	5
Deck crew	13
Engineer officers	4
Engineer crew	12
Purser's and steward's department	4
Total officers and crew	38
First-class passengers	
Second-class passengers	
Third-class passengers	
Total passengers	
Total complement	

Handling Equipment

	No.	Type	Capacity	Length
Masts	2	Pole	.....	.....
Derrick posts	2	....	.....	.....
Brooms	5	Wood	5-ton	40′ 0″
Brooms	8	Wood	5-ton	50′ 0″ to 57′ 0″

Deck Machinery

Steering Gear	Hyde screw gear 9″ × 9″
Windlass (1)	Hyde, 10″ × 14″ horiz.
Capstans (1)	Hyde 8″ × 8″
Winches (10),	Mead Morrison 7″ × 10″, single geared

Life Saving Equipment

	No.	Capacity	Length
Life boats	4	25 persons	22′ 6″
Work boat	1		16′ 0″

Propelling Machinery

Boilers

Number	3
Type	Single ended Scotch
Length	11′ 6″
Diameter	15′ 9″
Furnaces, each boiler	4
Fuel	coal or oil
Draft	natural
Total heating surface, square feet	8,250
Total gate surface, square feet	240
Superheat, degrees F.	none
Working pressure, lbs. per sq. in.	180
Normal fuel consumption:	
Per day, tons,	coal 36, oil 25
Per shaft horsepower hour pounds	coal 1.65, oil 1.15
Normal steam production:	
Per hour per pound of fuel	lbs.
Total per hour	30,000 lbs.

Engines

Number	(1) H. P. — (1) L. P.
Type	Parsons turbines
Size	1,100 nominal H. P. each
Horsepower, total shaft	2,200

Propellers

Number	1
Type	4 bladed, built up
Weight	26,000 lbs.
Diameter	17′ 3″
Pitch	16′ 6″
R. P. M.	75
Projected area, sq. ft.	85
Developed area, sq. ft.	95

Auxiliary Machinery

Machinery Space

Condenser, (1) main, 2,758 sq. ft. cooling surface.

Condenser, aux. (1) 1,000 sq. ft. cooling surface.

Evaporator, (1)	Reilly-Goodgall
Distiller	
Filters	
Feed water heater, (1)	Reilly
Fuel oil heaters, (2)	Dahl

Pumps

(1) Main air twin beam.... 10 × 22 × 15
(2) Main feed, vert. simplex... 12×8×18
(1) Donkey feed, vert. duplex... 10×7×10
(1) Fire & bilge, hor. duplex 10×8½×12
(1) Aux. air & circ., hor. simplex 10 × 12 × 12 × 12
(1) Evap. feed, vert. simplex.. 3½×4×4
(1) Fresh water, vert. simplex.. 3½×4×4
(2) Lub. oil vert. simplex..... 6×7×12
(1) Ballast, hor. duplex ..... 12×14×12
(2) F. O. Service, hor. duplex 5¼ × 3½ × 5
(1) F. O. Transfer, hor. duplex 6 × 5¾ × 6
(1) Amm. cond. circ., hor. duplex 5¼ × 3½ × 5

Refrigerating Machinery

(2) 1-ton Brunswick machines

Electric Equipment

Generator, (1)	15 K. W., General Electric
Radio,	2 K. W. Simon
Emergency	none

Holds

No.	Length	Hatches
1	54′ 0″	18′ × 27′
2	89′ 0″	18′ × 27′ and 18′ × 15′ 9″
3	67′ 6″	18′ × 27′
4	56′ 0″	18′ × 27′

Capacities

Cargo Space

Compartment	Cu. ft.
Hold, No. 1	54,162
" No. 2	99,367
" No. 3	72,157
" No. 4	48,987
'Tween dk. No. 1	24,390
" " No. 2	45,020
" " No. 3	35,362
" " No. 4	30,030
Bridge	30,632

Refrigerated Space

Compartment	Cu. Ft.
Ship's cold storage	1,120

Coal Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons
Cross bunker	22,596	.....	538
Hanging bunker	7,155	.....	170.3
Reserve bridge	34,138	.....	812.8
Total	63,889	.....	1,521.1

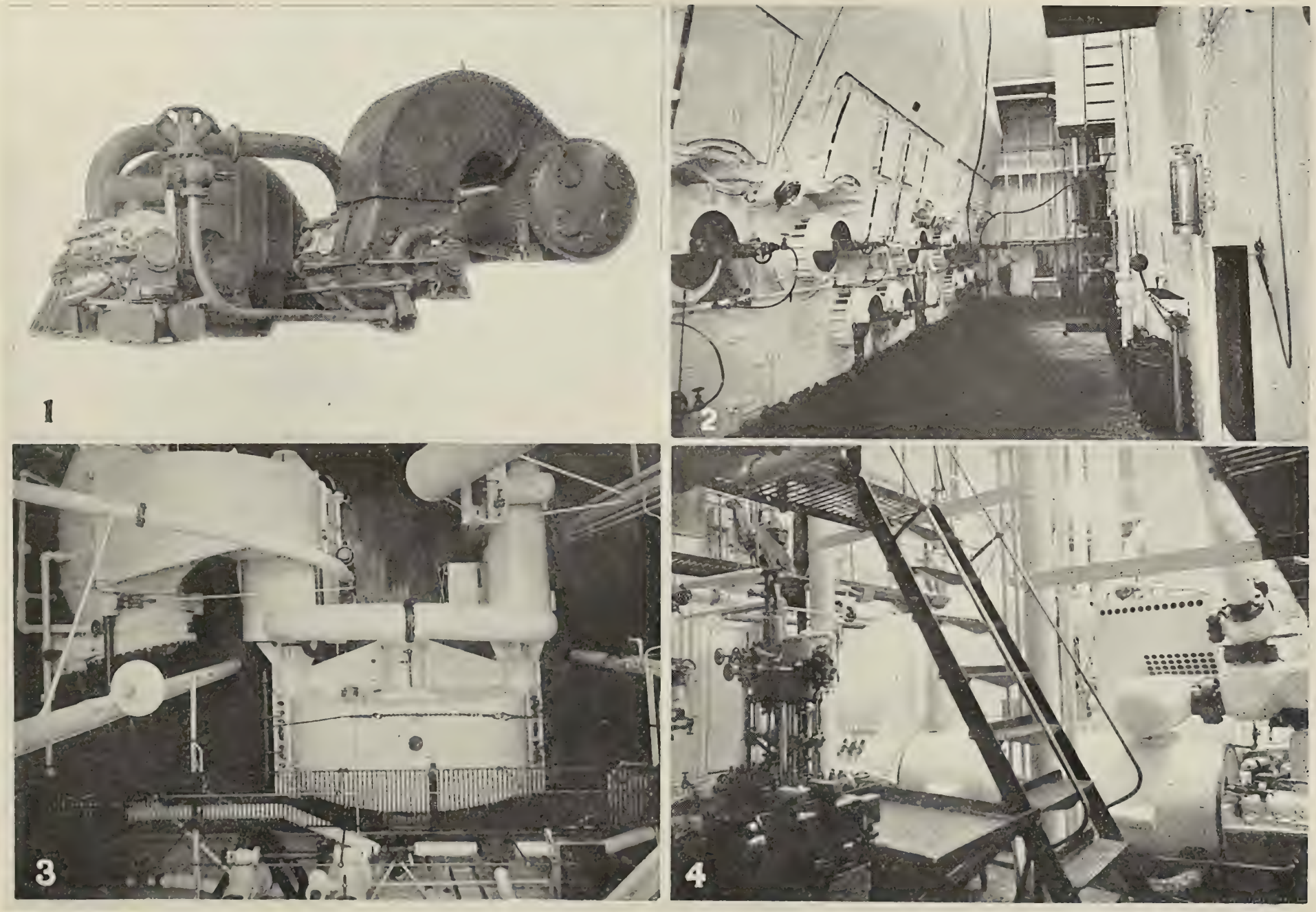
Oil Bunkers

Dbl. bot. tank No. 1.	7,310	1,302.1	.....
" " " " 2.	20,704	3,697.5	.....
" " " " 5.	14,480	2,579.0	.....
" " " " 6.	4,374	779.3	.....
Settling tanks	1,500	267.2	.....
Total	48,368	8,615.1	

*42 cu. ft. per ton; ..... 42 gals. per bbl.

Tanks

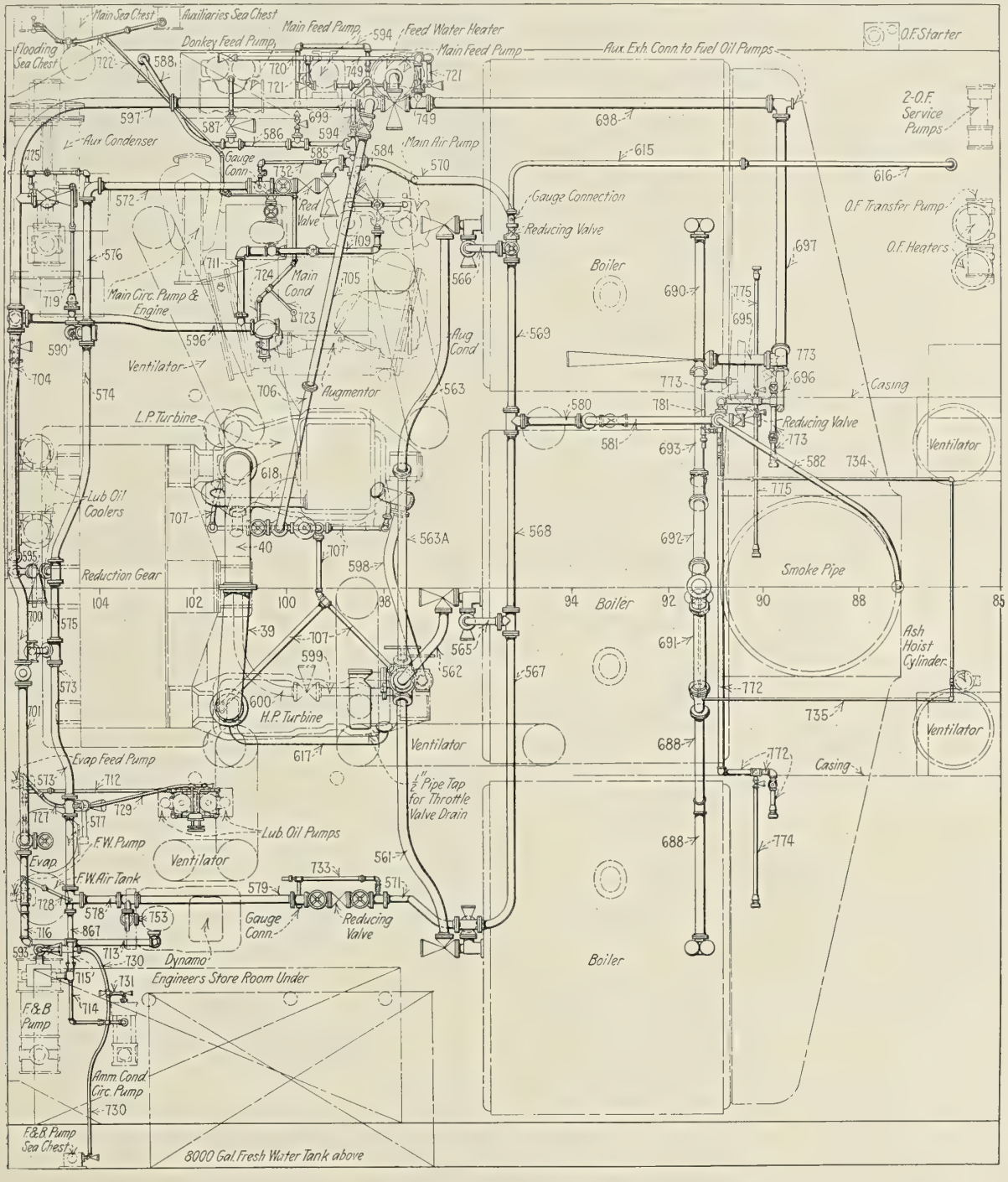
Compartment	Cu. Ft.	Tons F. W.	Tons S. W.
Fore peak	11,081	307.8	.....
Dbl. bot. tank No. 1.	7,310	.....	208.9
" " " " 2.	20,704	.....	591.5
" " " " 3.	7,422	.....	212
" " " " 4.	5,634	156.5	.....
" " " " 5.	14,480	.....	413.7
" " " " 6.	4,374	.....	125
After peak	11,662	.....	333.2
Total	82,667	464.3	1,884.3



Machinery of S. S. Thomas P. Beal: (1) Turbines, Gear and Condenser Erected in Shop. (2) View of Boiler Room. (3) View of Engine Room, Looking Down from Upper Grating. (4) View of Engine Room Looking to Port.

and boiler casings and a forecastle 38 feet long. Six steel watertight transverse bulkheads are fitted. A cellular double bottom extends the entire length between the peak bulkheads and is fitted for the carriage of either fuel oil or water ballast, except the space under the engine room which is used while the after one encloses the engine and boiler casings and contains the engineers' quarters, galley, etc. The crew is housed in the forecastle and the poop contains the hospital, lamp room and steward's room.

The vessel is equipped with four 22-foot 6-inch metal



Plan of Machinery Space

for reserve feed water. Deep settling tanks are built on the port side of the cross bunker extending from the tank top to the main deck. The fore peak is fitted for fresh water and the after peak as a ballast tank.

The large fuel oil capacity given provides a cruising radius of about 11,000 miles at 10 knots loaded. If it is desired at any time to use coal as fuel, the bridge space, wing bunkers and cross bunker and also the after end of No. 2 hold can all be utilized for bunkers without any structural alterations.

Two steel deck houses are built on the bridge, the forward one containing the captain's and navigating officers' quarters and forming a support for the wooden charthouse above, lifeboats on the after deck house and one 16-foot wooden boat on the starboard side of the upper bridge.

Cargo Space

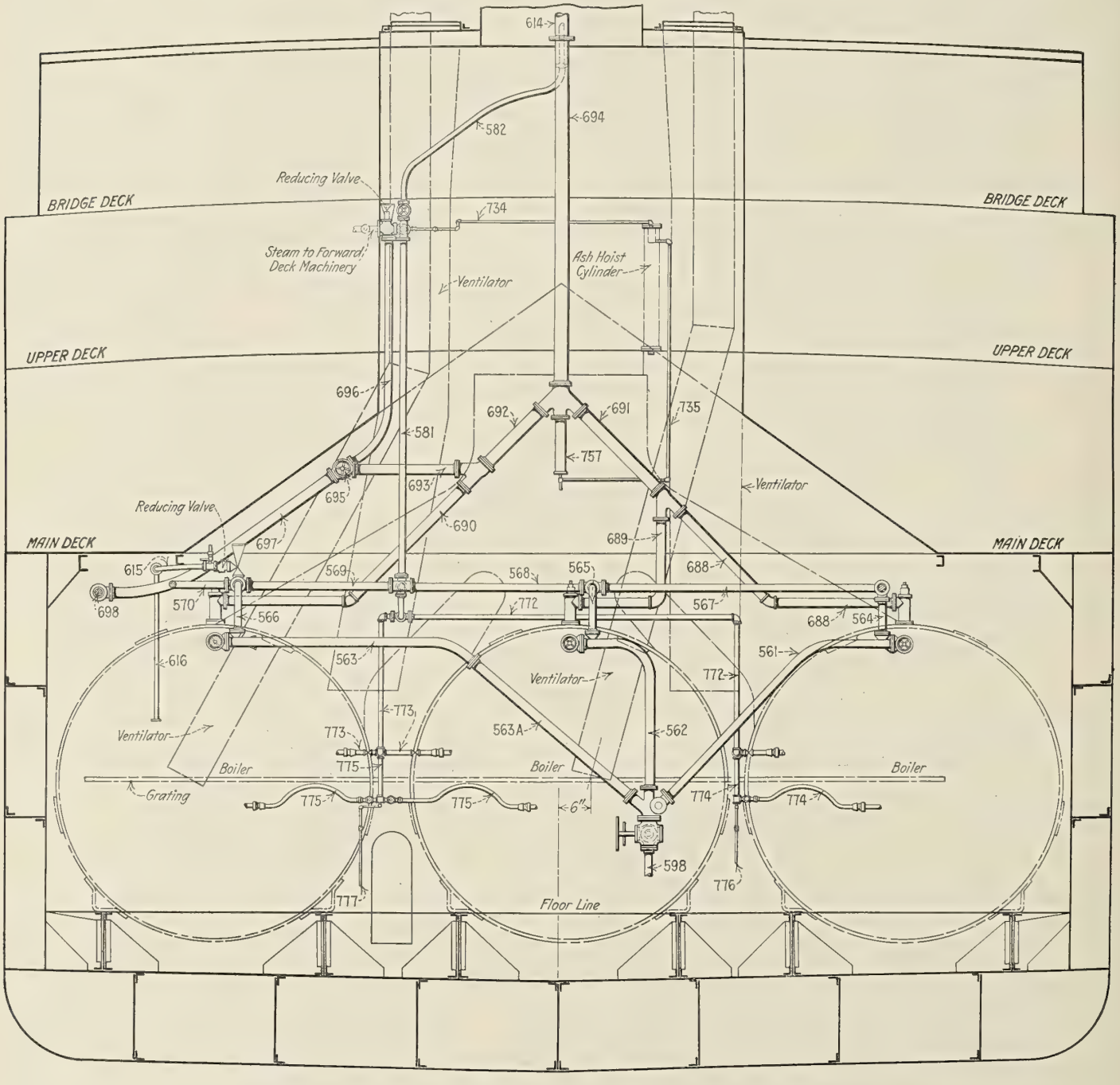
The under deck space has been divided into four main cargo holds, each with 'tween deck space above the main deck. In No. 2 hold provision has been made for fitting a wooden bulkhead near the after end to form an extra reserve bunker if found necessary.

Cargo Handling Gear and Deck Auxiliaries

Four 5-ton Oregon pine booms are provided at each mast and one 5-ton boom at each king post on the bridge deck.

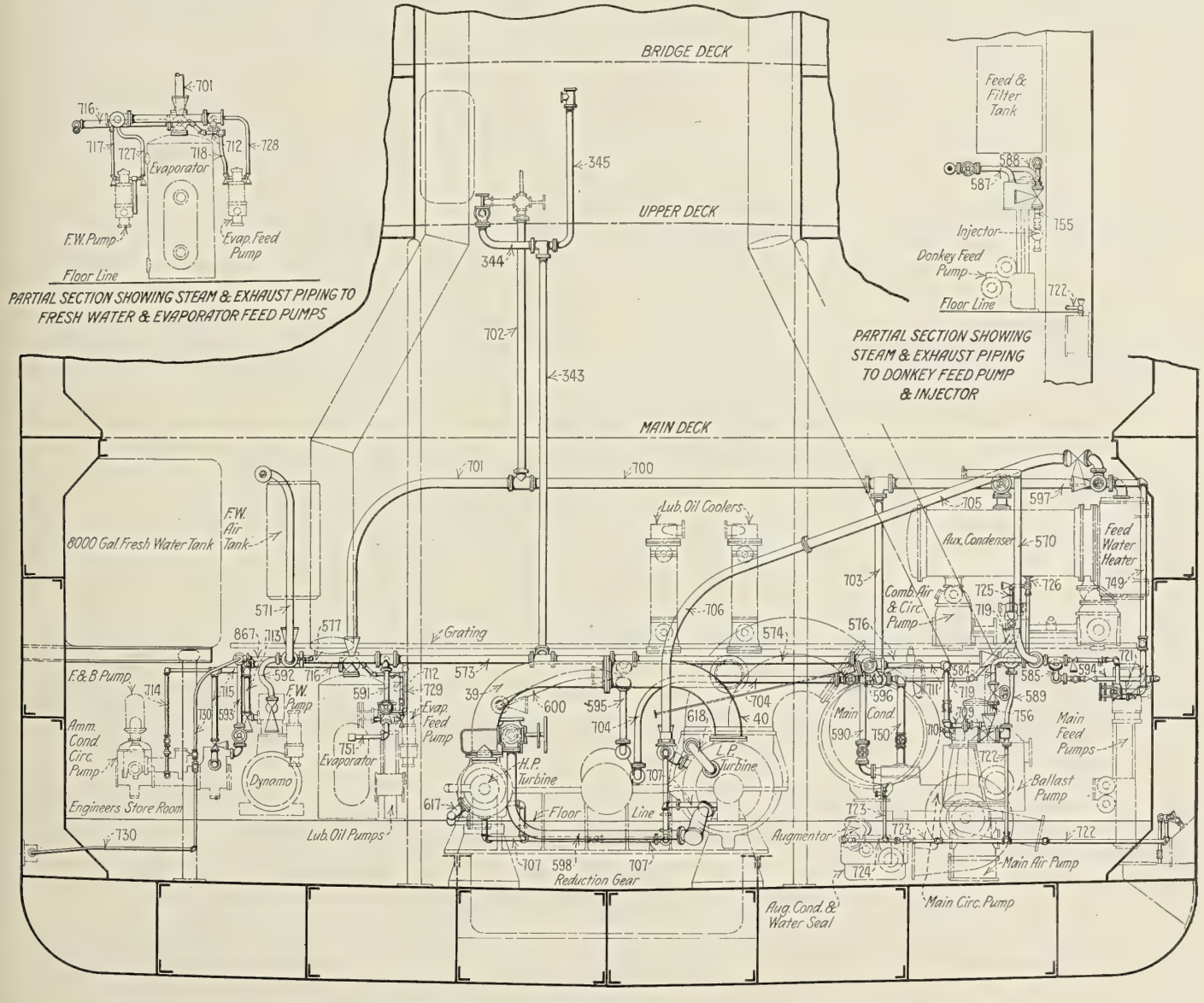
LIST OF PIPES COMPRISING THE STEAM AND EXHAUST SYSTEM

Mark	Nominal Size, Inches	Material	Test Press., Lbs.	Service
39	14	Copper	50	L. P. turbine receiver pipe.
40	14	Copper	50	L. P. turbine receiver pipe.
343	3	Copper	360	Steam to aft deck mach. and smothn'g manifold.
344	3	Copper	360	Steam to aft deck machinery.
345	2	Copper	360	Steam to aft deck machinery.
561	4½	Copper	360	Main steam starboard boiler.
562	4½	Copper	360	Main steam center boiler.
563	4½	Copper	360	Main steam port boiler.
563A	4½	Copper	360	Main steam port boiler.
564	3½	Copper	360	Aux. steam starboard boiler.
565	3½	Copper	360	Aux. steam center boiler.
566	3½	Copper	360	Aux. steam port boiler.
567	3½	Copper	360	Aux. steam between starboard and center boilers.
568	3½	Copper	360	Aux. steam center to port.
569	3½	Copper	360	Aux. steam center to port.
570	3½	Copper	360	Aux. steam port side.
571	3½	Copper	360	Aux. steam starboard side.
572	3½	Copper	360	Aux. steam port.
573	3½	Copper	360	Aux. steam aft port side.
574	3½	Copper	360	Aux. steam aft port side.
575	3½	Copper	360	Aux. steam aft starboard side.
576	3½	Copper	360	Aux. steam aft starboard side.
577	3½	Copper	360	Aux. steam aft starboard side.
578	3½	Copper	360	Aux. steam starboard side.
579	3½	Copper	360	Aux. steam starboard side.
580	3	Copper	360	Aux. steam to forward deck mach. and soot blowers.
581	3	Copper	360	Aux. steam to forward deck mach. and whistle.
582	2	Copper	360	Steam to whistle.
583	2	Copper	360	Steam to soot blowers.
584	2	Copper	360	Steam to main air pump.
585	2½	Copper	360	Steam to feed pumps and injector.
586	2	Copper	360	Steam to donkey feed and injector.
587	2	Copper	360	Steam to donkey feed pump.
588	2	Copper	360	Steam to injector.
589	2	Copper	360	Steam to main circ. pump.
590	2½	Copper	360	Steam to ballast pump.
591	2	Copper	360	Steam to evaporator.
592	2	Copper	360	Steam to dynamos.
593	2	Copper	360	Steam to fire and bilge pump.
594	1½	Brass	...	Steam to feed pumps.
595	3	Copper	360	Steam to steering engine.
596	4	Copper	50	Aux. exhaust to main condenser.
597	5	Copper	50	Aux. exhaust port side.
598	4½	Copper	360	Backing steam.
599	4	Copper	360	Emergency steam to L. P. ahead.



S. S. Thomas P. Beal—Section in Way of Boilers, Looking Forward

Mark	Nominal Size, Inches	Material	Test Press., Lbs.	Service
600	4	Copper	360	Emergency steam to L. P. ahead.
614	7½	Copper	...	Escape pipe above house.
615	2	Copper	360	Steam to fuel oil system.
616	2	Copper	360	Steam to fuel oil system.
617	4	Copper	30	Equalizer pipe H. P. turbine.
618	4½	Copper	30	Equalizer pipe L. P. turbine.
688	4½	Steel	...	Escape pipe from starboard boiler.
689	4½	Steel	...	Escape pipe from center boiler.
690	4½	Steel	...	Escape pipe from port boiler.
691	6	Steel	...	Escape pipe from starboard and center boiler.
692	6	Steel	...	Escape pipe, port and aux. exh. to atmosphere.
693	5	Steel	...	Aux. exhaust to atmosphere.
694	8	Steel	...	Escape pipe.
695	5	Steel	...	Aux. exhaust to atmosphere.
696	4	Steel	...	Aux. exhaust from forward deck machinery.
697	5	Steel	...	Aux. exhaust from forward deck machinery.
698	5	Steel	...	Aux. exhaust from forward deck machinery.
699	5	Steel	...	Aux. exhaust in engine room, port.
700	4½	Steel	...	Aux. exhaust in engine room, aft.
701	4½	Steel	...	Aux. exhaust in engine room drop to evaporator.
702	3½	Steel	...	Aux. exhaust from aft deck machine bulkhead No. 106.
703	4	Steel	...	Aux. exhaust to main cond. and from steering engine.
704	3	Steel	...	Aux. exhaust from steering engine.
705	4	Steel	...	Auxiliary exhaust to L. P. receiver.
706	4	Steel	...	Auxiliary exhaust to L. P. receiver.
707	2	Steel	...	Gland steam piping.
708	5	Steel	...	Aux. exhaust to aux. condenser.
709	2½	Steel	...	Exhaust from main air pump.
710	2½	Steel	...	Exhaust from main circ. pump.
711	3½	Steel	...	Exhaust from main air and circ. pump.
712	1¼	Steel	...	Exhaust from lubricating oil pumps.
713	2½	Steel	...	Exhaust from dynamo.
714	1¼	Steel	...	Exhaust from ammonia cond. circ. pump.
715	2½	Steel	...	Exhaust from fire and bilge pump.
716	3½	Steel	...	Exhaust from fire and bilge pump and dynamo.
717	½	Steel	...	Exhaust from fresh water pump.
718	½	Steel	...	Exhaust from evap. feed pump.
719	2	Steel	...	Exhaust from comb. air and circ. pump.
720	2½	Steel	...	Exhaust from donkey feed pump.
721	2	Steel	...	Exhaust from main feed pumps.
722	1	Brass	...	Steam to port sea chests.
723	1	Brass	...	Steam to main condenser boiling out.
724	¾	Brass	...	Steam to augmentor.
725	1¼	Brass	...	Steam to combination air and circ. pump.
726	1	Brass	...	Steam to aux. condenser boiling out.
727	⅜	Brass	...	Steam to fresh water pump.
728	⅜	Brass	...	Steam to evap. feed pump.
729	1	Brass	...	Steam to lubrication oil pumps.
730	1	Brass	...	Steam to ammonia cond. circ., pump and sea chest.
731	¾	Brass	...	Steam to ammonia cond. circ. pump.
732	1	Brass	...	By-pass reducing valve, starboard side.
733	1	Brass	...	By-pass reducing valve, port.
734	½	Brass	...	Steam to ash hoist cylinder.
735	¾	Steel	...	Exhaust from ash hoist cylinder.
749	3	Steel	...	Exhaust from feed pumps to aux. exhaust line.
750	3	Steel	...	Exhaust from ballast pump.
751	2	Brass	...	Steam to evaporator.
752	2	Copper	...	Steam to F. and B. and ammonia cond. circ. pump.
753	2	Brass	...	Steam to dynamo.
754	1	Brass	...	Red. valve, by-pass steam to forward deck machinery.
755	2	Brass	...	Steam to injector.
756	2	Brass	...	Steam to main air pump.
757	6	Steel	...	Escape pipe drain.
781	1	Brass	...	By-pass reducing valve, steam to forward mach.
772	2	Steel	...	Steam to soot blowers, starboard boiler.
773	2	Steel	...	Steam to soot blowers, port and center boilers.
774	1¼	Steel	...	Steam to soot blower, starboard boiler.
775	1¼	Steel	...	Steam to soot blowers, port and center boilers.
776	⅜	Steel	...	Drain from steam to soot blower, starboard boiler.
777	⅜	Steel	...	Drain from steam to soot blowers, port and center boilers.
867	2	Copper	...	Steam to F. and B. and ammonia cond. circ. pumps.



Section Through Engine Room, Looking Aft

The cargo hoists are handled by 7-inch by 10-inch single-geared winches, one to each boom.

A windlass is provided on the forecastle and a warping capstan on the poop.

Steam steering gear is installed in the poop, controlled by telemotor from the pilot house.

Large cargo hatches 18 feet by 27 feet are provided in both the upper and main deck to each cargo hold and in addition a hatch 18 feet by 15 feet 9 inches is provided to the bridge space and the after end of number 2 hold. Trimming hatches are fitted in the bridge space so that this may be used as a reserve bunker if so desired.

Main Propelling Machinery

The propelling machinery is a geared steam turbine drive of about 2,200 maximum shaft horsepower, designed and built by the Bath Iron Works. It consists of one high pressure and one low pressure turbine driving a single reduction gear coupled to a single screw.

The steam is supplied by three Scotch boilers using natural draft and equipped to burn either coal or oil fuel.

The main turbines are of the Parsons type designed for about equal power, i. e., 1,100 shaft horsepower each, and run at about 1,600 revolutions at full power.

The high pressure turbine is designed to take steam at 170 pounds and expand it, through 64 rows of blades, arranged in eight expansions and three rotor steps, to about atmospheric pressure in the receiver.

The low pressure turbine takes steam at atmospheric pressure and exhausts to the condenser. There are twenty rows of blades in the low pressure ahead turbine and twenty-one rows in the astern turbine, which is incorporated in the low pressure turbine casing. The low pressure blading is especially designed to enable the turbine to take advantage of high vacuum.

Dummies, the diameters of which are calculated to balance automatically all steam thrust under full power conditions, are fitted to all turbines and any small unbalanced thrust or axial adjustment is provided for in the Kingsbury thrust bearings fitted at the forward end of each turbine.

A flexible coupling is fitted between the turbine rotor and pinions to permit the independent axial adjustment of either.

The high pressure rotor is a solid forging, and the low pressure rotor is of hollow drum construction with the spindle ends in separate forgings.

By special care in the design of the turbines the drainage is automatic except for one small pocket, for which a hand drain had to be provided and which is so small that should it be forgotten during operation it is not likely to cause any damage.

Similarly the sealing of the glands is controlled entirely by one valve, a specially designed automatic one, and experience showed on the trials that this required no attention at all.

Provision is made for putting any excess auxiliary exhaust that may be available into the low pressure receiver or to draw therefrom in case there is a deficiency of steam in the feed water heater.

A single reduction gear is employed to transmit the power from the turbines to the main shaft and at the same time reduce the revolutions from 1,600 at the turbines to 75 on the shaft. The main gear is 130 inches in diameter and has a total width of face of 32 inches. The pinions are 6.25 inches pitch circle diameter and the tooth pressure at full power is about 375 pounds per inch of face, a very conservative value for the load on the teeth.

In connection with the installation of single gearing it is interesting to note that in order to reduce the amount of shaft tunnel space and so give maximum cubic capacity, the center keel and tank top have been cut to form a recess for the gear box, thus bringing the shaft as low as possible.

A feature of the design of the gear box is the lower casing, which was made larger than usual in order to form the oil drain tank for the whole lubrication system. An automatic float control is arranged to keep the level of oil in gear box within reasonable limits and to insure proper circulation in the system.

The gear wheel is built up of forgings and heavy plates. The rim was supplied, and the teeth cut, by the Parsons Company and assembled and completed by the Bath Iron Works. This design of wheel is very light when compared with the usual type, having a cast iron or cast steel center, the light design being advantageous in this case because the reduction in mass moment of inertia has the effect of increasing the natural frequency of torsional vibration of the shaft, thus augmenting the difference between this frequency and the normal full power revolutions and reducing the range of variation of stress in the shaft.

The teeth are of the herringbone type, cut on the creep principle 0.677 inch circular pitch and about 30 degrees helical angle.

The entire propeller thrust is taken by a 21-inch Kingsbury bearing fitted to the forward end of the gear shaft.

Forced lubrication is provided to all turbine, gear and thrust bearings. The system is a gravity one and includes the usual pumps, strainer, tanks and coolers, all in duplicate.

Steam to the lubricating oil pumps is controlled by a chronometer valve actuated by a float in the pan of the gear box, which forms the drain tank for the system, and the level of the oil therein is kept within two or three inches of the desired level. The pumps discharge through strainers to the coolers and thence to the supply tanks located high up in the engine room casing.

Supply pipes lead from the tanks to the bearings.

Automatic telltales mounted on the handling platform show the level of oil in the supply tanks and an automatic steam whistle alarm is fitted to give warning of a fall in oil pressure at the bearings.

A condenser having 2,750 square feet of cooling surface is installed, specially designed to provide the high vacuum of which the turbines can take advantage. The tubes are ¾ inch diameter and are expanded into the tube sheets.

A vacuum augmentor is installed to assist the twin beam vertical air pump to maintain the high vacuum obtained on the trial, viz., 28.5 inches at the top of condenser at full power, measured by the absolute mercury column.

Boilers

Steam is generated in three Scotch boilers 15 feet 9 inches diameter and 11 feet 6 inches long, designed for a working pressure of 180 pounds per square inch. Each boiler has four furnaces and separate combustion chambers to each furnace. The vessel as delivered was equipped for oil burning with a Dahl system, but carries on board a full set of furnace fronts, grates and bearers for coal burning, which can be installed in a few hours.

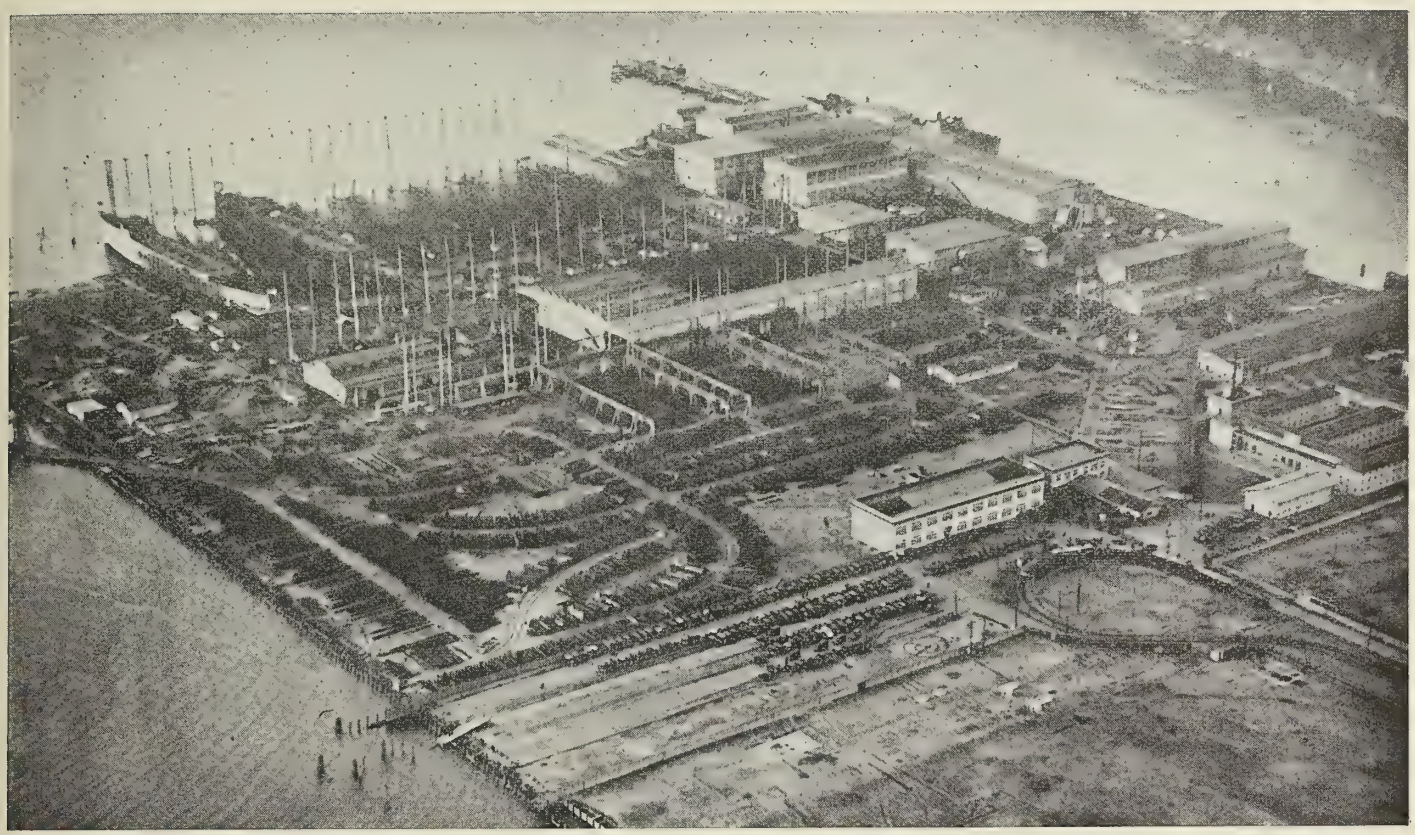
The coal bunkers can be used for cargo when coal is not being carried, oil fuel being stowed in the double bottoms.

The vessel has a cruising radius of 11,000 miles on oil and 4,700 miles on coal, using permanent bunkers only.

Consumptions

Water measurements were not made on the trial of the vessel but based on calculations checked by numerous trials conducted by the same builders when water was measured. The steam consumption at full power is about 11.8 pounds per shaft horsepower for turbines only, which is about 18 percent less than that of a reciprocating engine of equal power.

The coal consumption at 10 knots will be about 36 tons per day and the oil 25 tons or 163 barrels a day.



View of Todd Tacoma Plant from Airplane

Todd Corporation's Model Shipyard at Tacoma

Plant Specially Designed and Arranged for Economical Handling of Materials—Has Connections with Four Trans-Continental Railroads

THE lull in shipbuilding activities during the inevitable reconstruction period following the war has created a competition among the shipyards which is so strong that only those most modern in type are able to stay in the game and secure enough work to pay expenses.

During the war, when the vital need of the allied governments was ships and more ships, any means for producing these necessary vessels were encouraged until the list of shipyards in the United States swelled to proportions never before equaled in the history of the nation. With the ability of any type yard to secure all the work it could handle at the prevailing, excessive, war-time prices, many of those who undertook to establish shipyards did not prepare for the lean period which was bound to follow the war, or, in trying to do so, were handicapped by the scarcity of trained men in the profession whose advice is so essential. The result was that when the first blow came many closed their doors and retired from the business.

The Todd Dry Dock & Construction Corporation's plant at Tacoma, Wash., is one of the new yards which was planned with forethought and is representative of the modern trend in efficient shipyard operation.

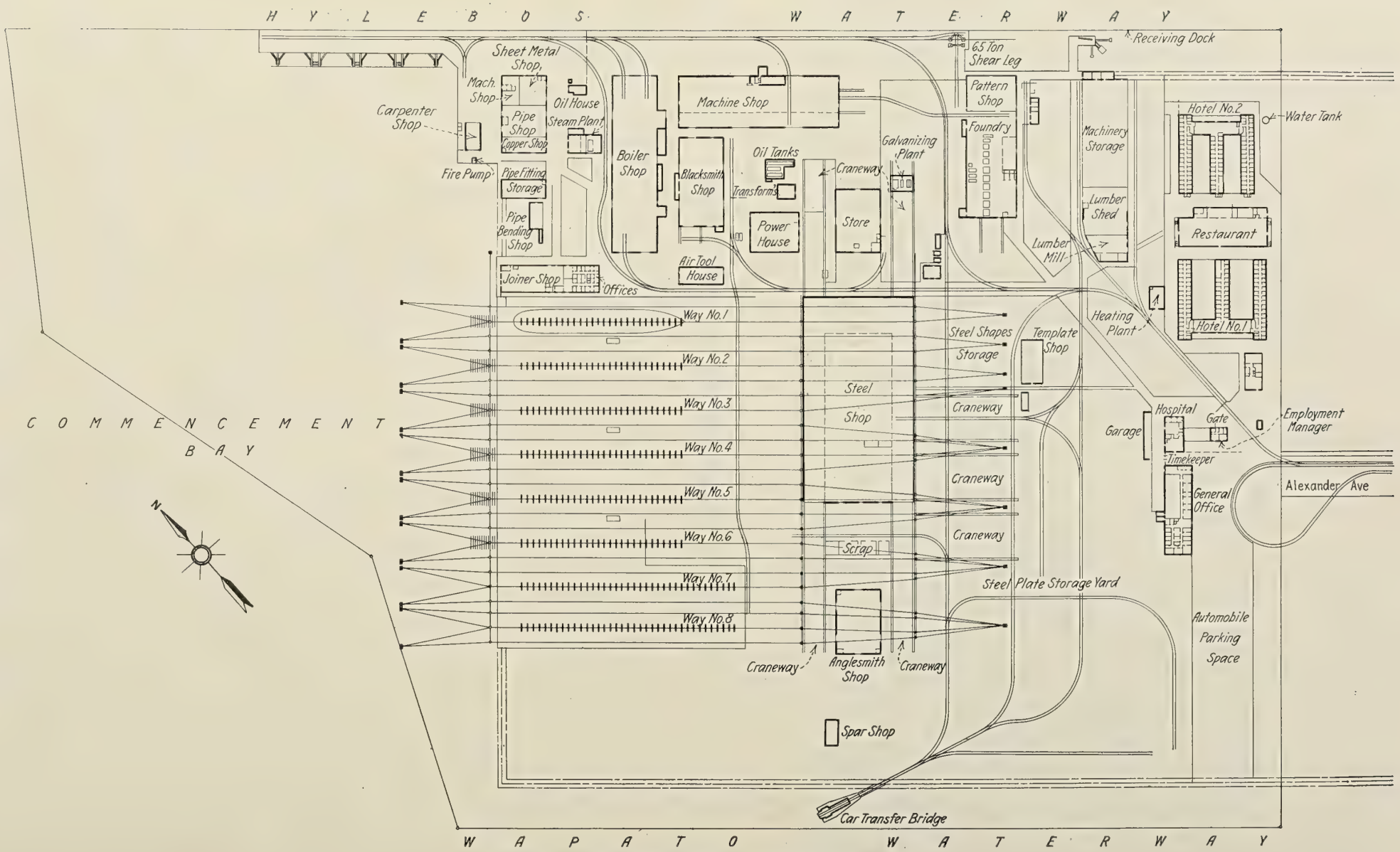
The actual yard area comprises about 65 acres of filled land inside of bulkheads, having deep water on three sides of it and providing a waterfront of 1¼ miles. Twenty-five acres of filled area are paved for working spaces and roadways and there are 16 acres of floor space in the shops. Wharfage space, totaling 1,800 feet, is provided on the east side for outfitting purposes.

The entire arrangement of shops and buildings was conceived with the idea of straight line progress of material from receipt at the yard to installation aboard a vessel. Ample railroad facilities connect the yard to four trans-continental roads and the various shops are inter-connected with three miles of track. In addition to this, there are 1¼ miles of crane ways within the buildings which provide for the handling of all material by efficient machinery at a saving in time and labor.

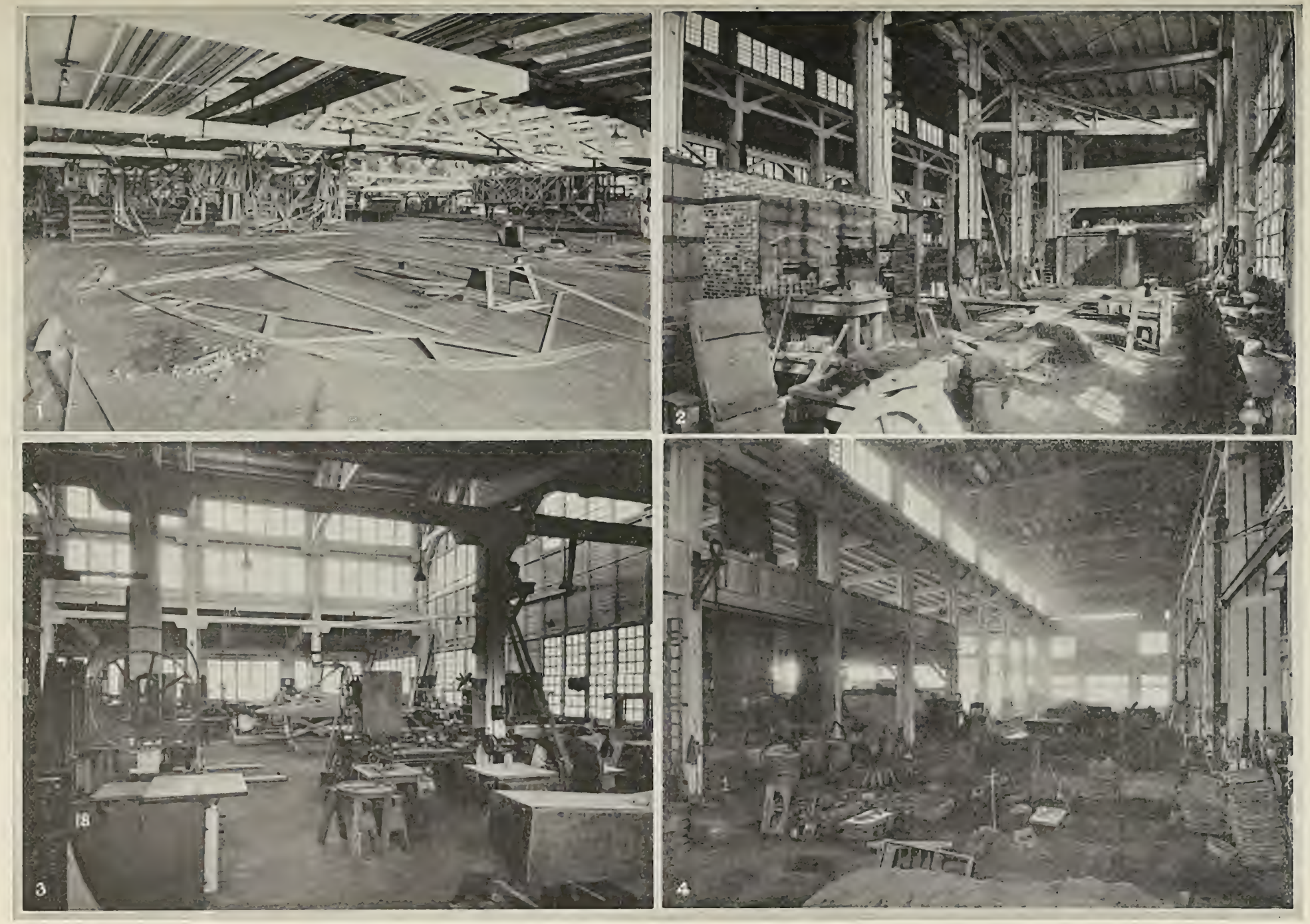
Facilities for handling structural material from the shops to the ways is provided for by aerial cableways, three of which extend over each of the eight ways. In all there are about 2 miles of such cableways and these extend not only over the vessels on the ways but cover the assembly space between the ways and the fabricating shop, thus providing an easy means of erecting, fabricating and assembling material.

Power Plant

The power for operating the mechanical equipment of the entire yard is generated and controlled in a power house of thoroughly modern design. Electric power for operating the machinery is distributed under ground through six miles of lead-covered cable in concrete conduits. Control power for all shops is obtained from a switchboard in the power house. There are also located in the power house seven Ingersoll-Rand compressors of 2,100 cubic feet capacity and one Allis-Chalmers compressor of 2,600 cubic feet capacity, giving a combined air capacity of 17,300 cubic feet per minute. This is distributed to the ways through a 16-inch high pressure air main and by means of smaller mains throughout the yard to the various shops, the outfitting wharf and



Plan of Todd Model Shipyard at Tacoma, Wash.



Interior Views in Shops at Todd Tacoma Plant: (1) Mold Loft, (2) Coremakers' Side of Foundry, Showing Core Ovens, (3) Section of Pattern Shop, (4) Foundry

the assembling yard, making a total of over 2 miles of air mains of all sizes.

Fabricating Shop and Mold Loft

The fabricating shop is located at the head of the ways and is 380 feet long by 150 feet wide. The laying off and finishing bay are served by means of 5-ton electric cranes and the transportation of material across the shop for its various operations is cared for by means of lighter electric cranes operated from the shop floor. The second floor of the fabricating shop is utilized as a mold loft and the extensive floor space gives ample room for this purpose. A separate shop is provided for anglesmith work, situated adjacent to the fabricating shop.

Foundry and Pattern Shops

The foundry and pattern shops are located in a building 111 feet by 320 feet in plan; an 80-foot two-story portion of which is utilized for a pattern shop on the second floor and pattern storage on the first floor. The balance of the shop, 240 feet in length, comprises the foundry and contains all modern machinery and equipment for the economical making of gray iron and brass castings. Concrete beds are provided for heavy castings such as cylinders, bedplates, engine columns, etc., and heavy electric cranes provide adequate means for handling material within the shop.

Machine Shop

Direct rail connection from the foundry to the machine shop provides for efficient handling of castings for finishing. This shop is of the type with a bay down the center extending to the roof and two side bays two stories high. The central bay is served by two 50-ton cranes and in this portion is located the heavy lathes, presses and mills and the platen for engine erection purposes. The side bays are equipped with the various tools and equipment for lighter work thus fitting this shop for the complete handling of all classes of work a machine shop may be called upon to do.

The tools in the machine shop are so arranged with reference to the class of work they perform that all material progresses steadily towards the center of the shop and the erection platen from which point it goes directly to the outfitting wharf as completed material ready for installation.

Blacksmith and Boiler Shops

The blacksmith and boiler shops are fully equipped along modern lines for handling any work in this direction that may arise. The feature of the blacksmith shop is the steam hammer equipment which ranges in size from 200 to 6,000 pounds' capacity sufficient for the economical handling of all classes of work.

The boiler shop is divided into two bays and served by 50-ton electric cranes. In both these shops the same idea of efficient material handling has been carried out so that the work progresses through the various operations from one end of the shop to the other and thence out via railroad transportation to the outfitting wharf.

Other buildings include a lumber mill, paint and joiner shops, a two-story storehouse, machinery storage building and a two-story building containing a pipe shop, copper shop and sheet metal shop on the first floor and a rigging loft and electrical shop on the second floor.

The Tacoma plant of the Todd Corporation is located on Puget Sound on a site that three years ago lay under 18 feet of water. Since that time it has established a fine record having launched twenty-six 7,500-ton steel hulls, a 6,500-ton motorship and three scout cruisers for the United States Navy.

(Photograph by Kadel & Herbert News Service, N. Y.)

Some of the Battleships the United States Would Scrap in Accordance with Disarmament Plans: (1) U. S. S. Georgia, (2) U. S. S. Missouri, (3) U. S. S. Connecticut, (4) U. S. S. Washington (Latest Type, Electrically Driven), (5) U. S. S. Vermont

Electric Propulsion of Ships*

By W. E. Thau†

This paper deals primarily with the electric propulsion of ships, except wherein a comparison of some particular feature or characteristic warrants a reference to some other type of drive. In dealing with electric propulsion, it is necessary to consider all classes of ships, and this leads to two broad, general classifications, such as merchant ships and war vessels, which are taken up in the order named in the paper.

THE ultimate purpose of a merchant ship is to earn money. From this standpoint, the factors of reliability, economy, weight, space, cost, operation and maintenance are involved in the propulsive equipment. Therefore the type of drive most suitable is that which excels in all or the most important of these factors. The relative importance of these items varies with different ships, depending upon the trade route, cargo, etc., with the result that there is a definite and logical field for each of the principal types of drives, such as reciprocating engine, geared turbine, turbine-electric, Diesel and Diesel-electric. Since many general comparisons of the principal types of drives in regard to these factors have been given in recent articles in the technical press it is not the intent of the present paper to take up this phase of the subject, but rather to analyze the principal types of electric propulsive equipments and to show in general how they fulfill these requirements.

Reliability

The universal use of, and the indisputable success of electrical apparatus on land is sufficient testimony in behalf of its reliability. The absence of reciprocating parts makes electrical apparatus with its simple rotation as reliable as can be desired. It can almost be said that there are no mechanical troubles with electrical machinery. Broadly speaking, there are no new principles involved in the application of electrical apparatus to ship propulsion. It is true that ship conditions differ from land conditions in certain respects, but there is no phase of the application which presents any really serious difficulty. The most important adverse condition is the deleterious effect of salt and moisture, which is easily surmounted by proper insulation of the windings and circuits, as is obvious from the several years of successful operation of present electric propulsion equipments. There can, therefore, be no question as to the reliability of electrical propulsive equipment.

Economy

Economy is an important factor, and must be given due consideration. To properly analyze this item, it is necessary to consider all equipment involved in the propulsion, with respect to fuel, water, lubricants and supplies. The relative proportions of these items vary considerably in the different types of propulsive equipments. The turbine-electric and the geared turbine compare very closely in economy when all items are considered. The losses in the reversing elements of geared turbines, the losses in the gears and the power required to circulate the additional lubricating oil, detract appreciably from the gain which the geared turbine would otherwise have over the turbine-electric because of the inherent electrical losses in the latter. Generally speaking, the net economy of a properly designed and constructed geared turbine drive should be better than a turbine-electric drive, even though full advantage is taken of every practical source of gain in the latter. The difference, however, is perhaps hardly of sufficient magnitude to be the dominating factor in arriving at a final selection. The economy of a reciprocating engine drive is obviously poorer than that of a properly designed turbine drive of either type for the reason that the reciprocating engine cannot utilize the same expansion of the steam.

It has been advanced that the turbine for the turbine-electric system, being a one-direction rotation machine, can utilize higher superheat than the geared turbine, because of the reversing element of the latter, thus resulting in better overall economy. With the present installations, this condition is true to some extent. However, with proper attention given to this factor, geared turbines can be designed to operate without detriment with steam superheated 150 to 200 degrees F., which is fairly close to the practical limit of superheat on board ship, as there are other items aside from the turbines which are affected by high superheats to the extent of fixing limitations.

Obviously from a fuel consumption standpoint, the direct Diesel and Diesel-electric propulsive equipments offer by far the best economy. Of these two types, it would appear, offhand, that the direct Diesel drive is decidedly superior to the Diesel-electric; however, it will be shown later that there are certain limitations in the direct Diesel drive which offset its advantage in fuel per brake horse-power-hour over the Diesel-electric. Here again, it is obvious that all items related to the propulsive equipment must be taken into consideration to obtain the ultimate answer.

Weight

The item of weight would probably show more variance than other items owing to differences of arrangement, design, foundations, etc., in the practice of the several shipbuilders. The importance of weight depends upon the type of ship, cargo, and trade route. Usually, however, weight is an important item as it has a direct effect upon the total fuel consumption and the amount of cargo that can be carried with a given displacement. Here again, it is necessary to consider all items related to the propulsive equipment. A correct comparison of weight necessitates that the equipments under consideration be on the same basis relative to overload, factor of safety and arrangement. This is particularly important in comparisons between electric drive equipments. Where one equipment affords an advantage in flexibility of reserve, however, it is usually at some sacrifice in weight, and an allowance must be made.

Space

Space is important in that it has a direct bearing upon the bulk of cargo that can be carried. Its relative importance depends somewhat upon the location of the machinery, *i. e.*, whether the machinery is located amidship or aft, or both. Space is affected by the distribution of machinery and the relative saving depends somewhat upon the practice of the various shipbuilders in that respect. General analysis of the space factors which have been made thus far gives the advantage to the direct connected Diesel and Diesel-electric types of propulsive equipment, the saving being effected by

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the elimination of the boilers and reduction of fuel and water tanks. Of the turbine-electric and geared turbine types, the space factor is in favor of the geared turbine, except in special cases. The general arrangement of the engine room, number of propellers and the beam of the ship have a direct effect upon the space occupied as a result of machinery distribution. By locating the condensers underneath the turbines in electric drives, the total floor space can be greatly reduced.

Cost

A definite comparison of costs is still a difficult task owing to the continued unsettled conditions. On the basis of equal performance in regard to propeller torque and speed, the cost including all items related to the propulsive equipment should run in the order of direct-Diesel, turbine-electric, geared turbine, and Diesel-electric, the latter being the

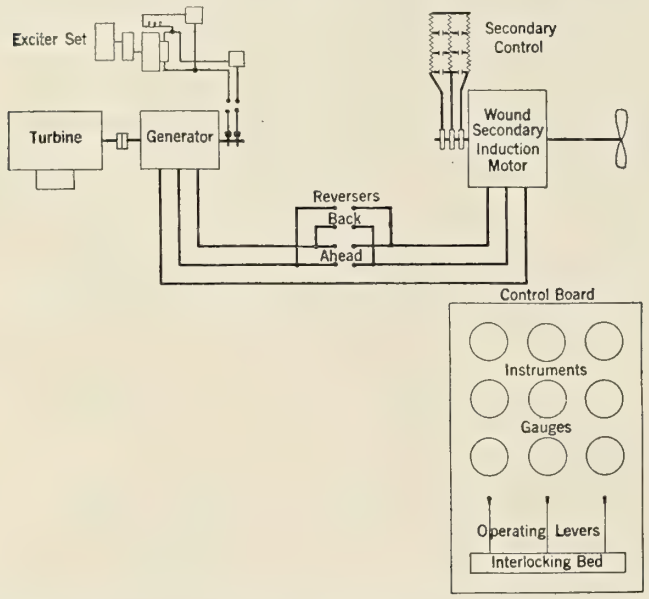


Fig. 1.—Diagrammatic Scheme of Connections for Wound-Secondary Induction-Motor Drive

cheapest. The paradox in the relative cost of direct-Diesel and Diesel-electric is explained by the condition that small Diesel engines and generators for Diesel-electric drives can be manufactured ultimately on a large production basis and stocked, whereas the engines for direct-Diesel drive, and to a large extent, the two types of turbine drive, because of their large size and weight, must almost of necessity be a building proposition. On the basis of standardized drives, there should not be a great deal in favor of the geared turbine as compared with the turbine-electric drive. This comparison will vary somewhat with the different manufacturers.

The initial cost of the propulsive equipment has a direct effect upon the net earning power of the ship, because of interest, depreciation and insurance charges, and therefore, cost is an important item.

Operation

In regard to operation, it is realized that the present operators are largely men who are more familiar with reciprocating engines than with other types of machinery, and that for this reason, certain difficulties are likely to be encountered in placing electrical equipments in their hands. The author believes that this thought should not be a consideration, as it is a temporary condition only. Successful operators of electrical machinery need not have sufficient knowledge of it to understand the details of its design. This is not the case on land and there is no greater reason for it on the sea. The operator should, however, know the operating characteristics of electrical apparatus and how to take care of it.

The same question was raised in the case of geared turbines only a few years ago, yet today there is nearly a sufficient number of competent geared turbine operators to take care of all the geared turbine ships. The same will be the case with operators for electric ships. It is merely a matter of training and education and it is certainly a reflection upon the intelligence of the age to classify the present limited knowledge as an obstacle for consideration.

The following is a probable list of the operating personnel for the principal types of drives. The cost of operating personnel as based upon this list would, therefore, be in the order of,—direct-connected Diesel, turbine-electric, geared turbine, reciprocating engine, and Diesel-electric:

TABLE OF PROBABLE OPERATING PERSONNEL

		Reciprocating engine *	Geared turbine *	Turbine electric *	Direct connected Diesel	Diesel electric
Total Crew	Chief	1	1	1	1	1
	1st Asst.	1	1	1	1	0
	2nd Asst.	1	1	1	1	1
	3rd Asst.	1	1	1	1	1
	Jr. Engrs.	0	0	0	3	0
	Electricians	0	0	1	1	1
	Oilers	3	3	3	6	6
	Firemen	6	6	6	0	0
	Total	13	13	14	14	10
On each watch	1st, 2d or 3d	1	1	1	1	1
	Junior Engrs.	0	0	0	1	0
	Electricians	0	0	0	0	0
	Oilers	1	1	1	2	2
	Firemen	2	2	2	0	0
	Total	4	4	4	4	3

*Based on oil burning ships. For coal ships, the operating personnel would be augmented by three coal passers.

Maintenance

Although there are practically no data available on the maintenance of electrical propulsive equipments (except battleships), there is no reason to anticipate any great difference between sea and land practice. As a matter of fact, there is reason to anticipate less maintenance for the reason that the load conditions and control operations are less severe than is the case with most land installations involving large machinery. If the equipment is given proper care and inspection, the maintenance item will be low, as the absence of rubbing parts (except for the bearings), leaves little to get out of order. Electrical machinery does not wear as is the case with other machinery. Furthermore, all probable repairs are such as can be made aboard the ship without the use of an elaborate machine shop.

Performance Characteristics

The inherent performance characteristics of electrical machines are particularly well suited to ship propulsion. Having identical operating characteristics in either direction of rotation, all types of electric drive inherently afford, or can be made to afford, full torque and power for reversal. For reasons of economy, space and cost, the reversing element of a geared turbine is designed to give only 40 percent to 60 percent power in the reverse direction. It has been claimed that full reverse power is not essential to a merchant ship, and this is true under ordinary conditions. In emergency, however, it is desirable to stop the ship very quickly, and in this connection it might be pointed out that the electric ship can be stopped in considerably less time than a geared turbine ship. This is not altogether the result of less backing power, but is due to a great extent to the inefficiency of the reversing element of the geared turbine causing an enormous draft on the boilers which greatly reduces the steam pressure.

In reversing, the energy put into the screws by the action

of the water and the stored energy in the rotating parts attached to the propeller shaft, must be dissipated in some manner. In the case of the geared turbine, this energy is consumed in doing work on the steam. In the case of alternating current electric drives, the energy of reversal is dissipated in the motor and generator windings, the rotors of the motors, or in external resistors connected to the rotor circuits, depending upon the type of motor used. In direct current electric drives, the reversal energy must be absorbed elsewhere in the system. The amount of energy to be dissipated or absorbed in the case of a given ship depends entirely upon the time taken to stop the screws. The instant the screws commence to turn over in the reverse direction, the system must supply the energy and all further stopping energy is dissipated at the propellers. There are two factors to be considered in stopping, namely, the energy returned through the propellers, and the stored energy in the propellers and the motor armatures. Analysis shows that reversing even at full speed is not a serious problem, and that it does not place as severe requirements upon the electrical machinery as does turning with hard-over rudder. The details of the distribution and absorption of the energy of reversal would occupy too much space to be discussed at this time. Suffice it for the present to say that the inherent facilities afforded by electrical systems for dissipating energy and for giving full power in either direction are what make the electric drives ideally suited for stopping. The time required to stop an electric ship is the same as, or less than, that of other drives.

Description of Electrical Propulsive Equipments

General Classification.—Electrical systems for ship propulsion may be classified into two general types from the standpoint of the prime movers, namely, turbine-electric and Diesel-electric. Due to the inherent performance of these two types of prime movers, both kinds of electric machinery are used; alternating current machinery with turbine-electric because the alternating current generator is inherently suitable for direct connection to the economical high-speed turbine; and direct current machinery with Diesel-electric drive because the inherent characteristics of the direct current generator are ideally suited to Diesel engine performance.

The electrical equipment for turbine-electric drive may be further subdivided as follows, in regard to the type of motor:

1 Induction
- Wound secondary
  - Ordinary, and with
  - power factor correction
- Squirrel cage
- Combined squirrel cage and wound secondary

2 Synchronous

In the case of the Diesel-electric drive, there is no broad subdivision. As a minor classification, this type of drive might be subdivided with respect to the method of generator operation, *i. e.*, series and parallel. However, series operation is so vastly superior that parallel operation can be disregarded except for the purpose of comparison.

Units Involved

A complete turbine-electric drive involves the following apparatus:

Boiler plant
Evaporation plant
Condenser plant
Turbine
Generator
Motor
Oiling system
Exciter set
Control

A complete Diesel-electric drive involves the following apparatus:

Diesel engines
Generators
Motors
Small auxiliary air compressors
Air bottles
Exciters
Fuel pumps, (if not attached to engine)
Lubricating pumps, (if not attached to engine)
Control

Turbine-Electric

With turbine-electric drive, the electrical equipment is of the alternating current type, principally for the reason that alternating current turbo generators are inherently better suited for the high economical speeds of turbines. The speed at which the turbine operates is influenced by the propeller speed because of the limitation in the number of poles of the motor. Theoretically, an alternating current motor can be built for any even number of poles, but in practice such factors as power factor (induction motor), diameter and assembly, fix the limit in the neighborhood of 60 to 72 poles. As the motor speed and number of poles fix the generator and turbine speed, there is consequently an approximately fixed limit to turbine speeds. Incidentally, in the case of practically all merchant ships, this speed is lower than the most economical speed of the turbine. As the propeller is most efficient when designed and operated at low speeds, it is advisable not to exceed 90 to 100 revolutions per minute for the ordinary merchant ship.

Assuming a propeller speed of 100 revolutions per minute, a 60-pole motor and a two-pole generator, the generator and consequently the turbine would operate at 3,000 revolutions per minute (neglecting the slip in case of the induction motor). This gives a reduction from the turbine to the propeller of 30:1, which is approximately the same irrespective of the type of motor used.

Fig. 1 shows a diagrammatic scheme of connections for an induction motor drive of the wound secondary type. Power is supplied from the turbine-driven generator to the induction motor through one of the reversers. The generator is excited from one of the auxiliary geared turbine direct current sets. Whether the auxiliary set would supply generator excitation only, or simultaneously furnish ship's auxiliary power, depends principally upon the electrification of engine room auxiliaries, winches, etc.

The turbine is under the control of a governor capable of maintaining constant speed over about 75 percent of the entire speed range. The governor speed control valve is regulated from the control stand by an oil relay valve or system of rods and levers, depending upon the type of governor used. The propeller speed is adjusted by throttling the turbine as in the case of a geared turbine drive. The turbine is started and brought up to its "idling speed" by the throttle valve at the turbine.

Similarly, the generator field switch and rheostat, and the ahead and back switches are controlled from the control stand by means of levers. These levers are mechanically interlocked so that it is necessary to follow the proper sequence of operations in starting, stopping and maneuvering.

Usually, the reverses are interlocked with the field lever so that the field lever must be in the "off" position before the reversers can be opened or closed. Similarly the field is interlocked with the turbine speed control lever so that the control valve must be set for low speed before the field can be opened or closed.

The secondary control is automatic, being either of the solenoid contactor or motor-operated contactor type. The actuating means is energized through contacts on the field lever near the end of its stroke. This arrangement insures the establishment of voltage at the motor before closing the secondary accelerating switches. Similarly, moving the field lever to the "off" position, opens the secondary switches.

The operating levers and a complete complement of electrical instruments and steam gages are arranged convenient to the operator, the instruments and gages being mounted on a panel directly above or in front of the levers. By observing the instruments, the operator will be kept informed at all times of the performance of all machines, even though

the machines be obscured from his view when he is on watch.

By a suitable arrangement of the switches and control levers, the entire maneuvering of a ship of any size and any number of screws, can be under the complete control of one operator.

The interlocking system necessitates the following sequence of operation:

A—Starting Ahead (Turbine Idling):

1. Close REVERSER in "Ahead" position,
2. Close FIELD and establish excitation,
3. Adjust TURBINE SPEED to desired value after secondary is completely short-circuited. (Indicated by pilot light)

B—Stopping:

1. Move TURBINE SPEED control lever to idling position,
2. Move FIELD lever to "off" position,
3. Move REVERSER to "off" position.

C—Starting Back:

1. Close REVERSER in "Back" position,
2. Close FIELD and establish excitation,
3. Adjust TURBINE SPEED to desired value after secondary is completely short-circuited.

D—Reversing (From Ahead Operation):

1. Move TURBINE SPEED control lever to idling position,
2. Move FIELD lever to "off" position,
3. Move REVERSER from "Ahead" to "Back" position,
4. Move FIELD lever to full excitation,
5. Bring up TURBINE SPEED after motor has pulled into step.

The above description applies to a single screw drive having but one turbine set. For a multiple screw ship having generating sets for port and starboard sides, the operation would be the same for each side of the ship, as just described.

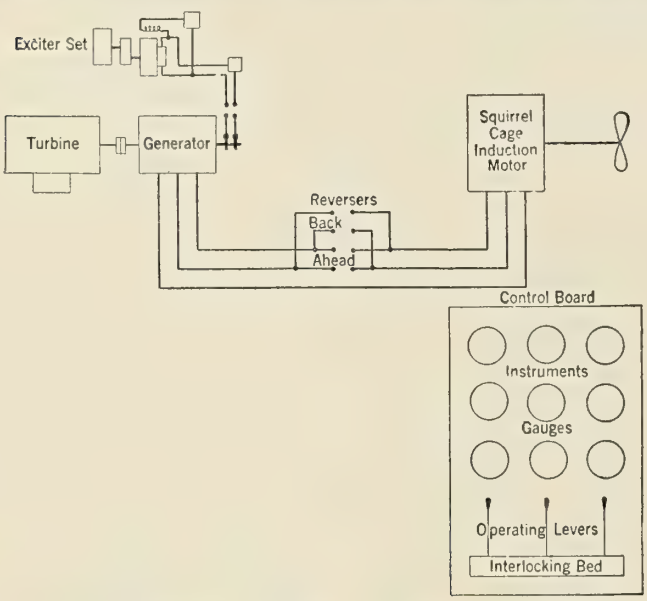


Fig. 2.—Diagrammatic Scheme of Connections for Squirrel-Cage Induction-Motor Drive

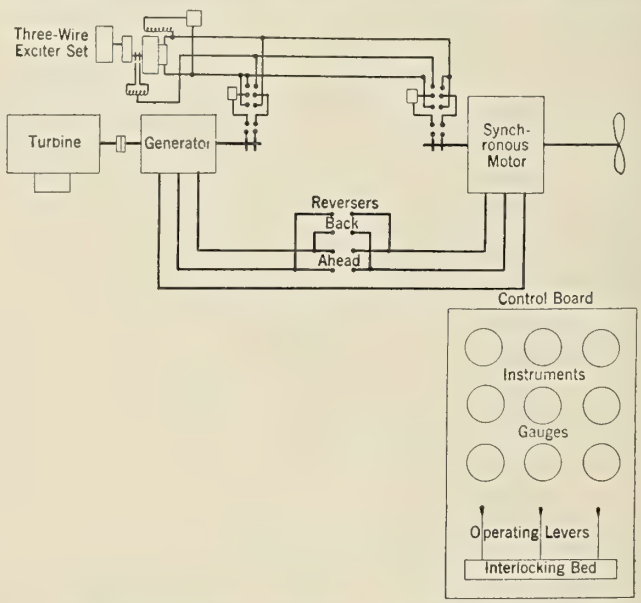


Fig. 3.—Diagrammatic Scheme of Connections for Synchronous Motor Drive

The above operations are based upon switching when the current in the circuits has been reduced to very low values, or nearly dead circuit conditions. This arrangement is not really necessary, as, with small powers, it is not essential to open the generator field; however, it may be justified in the light of conservatism. In any event, the reversers are so designed that they are entirely capable of opening full power.

The salient features of the wound-secondary-induction-motor drive are its inherent torque characteristics and the ease of handling. While the secondary control necessitates a few additional switches, this is fully compensated for by the fact that the propeller energy of reversal, and the slip energy of reversal and starting is dissipated in resistors external to the motor. The importance of this is dependent upon the amount of reversing that is done, particularly from full speed. This system, therefore, represents the most conservative arrangement of turbine electric drive.

The squirrel-cage motor system is shown in Fig. 2, and it will be noted that the electrical connections are the same as for the wound-secondary motor system, except that there is no secondary control. This system is, therefore, somewhat simpler than the wound-secondary motor system from an electrical connection standpoint, both inside and outside the motor. It also has a slight advantage in cost in that the motor is less expensive to build. The sqirrel-cage motor is shorter because of the absence of collector rings. It has a disadvantage in conservatism and torque characteristics.

The power factor of either of the induction motor systems is less than unity, the exact value depending upon the number of poles and certain design features. For the ordinary merchant ship requirements, these motors would have power factors of approximately 70 percent, the wound-secondary motor having the higher power factor of the two, by a small amount. The induction motor drive, therefore, requires a generator with kv-a. capacity in excess of its kilowatt capacity, which adds somewhat to its weight and size, and which detracts a very small amount from its efficiency.

The efficiency of the squirrel-cage induction motor of ordinary design is slightly less than that of the wound-secondary motor, for the reason that sufficient permanent resistance must be incorporated in the rotor windings to obtain the required torque for reversal without excessive current. In large motors with special double secondary windings, the required torque can be obtained without excessive current and the running efficiency can be improved somewhat. Such motors are in use on propeller drives at the present day.

TURBINE ELECTRIC

(Synchronous)

Fig. 3 shows a diagrammatic scheme of connections for a synchronous motor drive. Power is supplied from the turbine driven generator to the synchronous motor through one of the reversers. The generator and motor fields are excited from a three wire, direct current exciter set. The synchronous motor system differs from the induction motor system only insofar as the synchronous motor itself affects the details of control and generator capacity, the main features of turbine-electric drive being otherwise the same.

Although the characteristics of the ordinary synchronous motors are not suitable for ship propulsion, the synchronous

motor can be modified to give characteristics which meet the requirements. The modification consists in providing the rotor with a substantial induction winding of such design and arrangement as will not seriously detract from certain purely synchronous motor characteristics which are desirable.

The maneuvering operations can be accomplished in more than one way. If appreciable torque is required to reverse, the method which appears to be most favorable is to utilize the synchronous characteristics and the induction characteristics at different stages of the reversing cycle. The motor is stopped as a synchronous generator loading into the generator windings which form a dead load (generator field not being excited), then is brought up to nearly synchronous speed in the reverse direction as an induction motor, and finally is pulled into step with the generator as a synchronous motor. With this method, the sequence of operation for reversing would be approximately as follows:

1. Reduce turbine to idling speed (25 percent),
2. Open generator and motor fields,
3. Reverse motor connections,
4. Apply motor field excitation bringing motor to rest,
5. De-energize motor field,
6. Energize generator field to double value, bringing motor to nearly synchronous speed as induction motor,
7. Apply normal excitation to motor field, pulling motor into synchronism with generator,
8. Adjust speed to desired value.

The method described above is preferable where appreciable torque is required during reversing. Usually, however, sufficient torque will be developed by the simpler method of reversing as an induction motor, in which case the cycle of operation will be as follows:

1. Reduce turbine to idling speed (25 percent),
2. Open generator and motor fields,
3. Reverse motor connections,
4. Energize generator field to double value, bringing motor to rest and reversing it to nearly synchronous speed, as an induction motor,
5. Apply normal excitation to motor field, pulling motor into synchronism with generator.
6. Reduce generator field to normal,
7. Adjust speed to desired value.

This method, therefore, simplifies the sequence to the extent of omitting one step and eliminating the generator action of the synchronous motor.

Although eight and seven steps respectively have been indicated in the sequence, some of the steps can be combined so as to reduce the actual number of lever operations to a reasonable amount.

Although the synchronous motor requires special design and introduces additional complications in the control, it has the important inherent characteristic of unity power factor. The unity power factor results in slightly decreased weight and size, and consequently less cost of the motor and generator. Taking the drive as a whole, and considering that both motor and generator must be excited from a separate source at a cost of at least twice the steam per kilowatt-hour as the main turbine, the efficiency improvement over the induction motor drive is more apparent than real. Therefore, the principal advantages of the synchronous motor drive as compared with the ordinary induction motor drive are a slight saving in cost, weight and space, with a possible inappreciable margin of efficiency.

Turbine Electric

(Induction with Power Factor Correction)

The unity power factor advantage of the synchronous motor system is also available with a wound-secondary induction motor system in which the low lagging power factor is corrected to unity. This arrangement not only provides a system of the same weight, space and cost of the synchronous system, but in addition possesses the superior torque characteristics and simplicity of control of the wound-secondary induction system.

The diagrammatic scheme of connections is shown in Fig. 4. It will be noted that this is the same as the wound-secondary induction motor system shown in Fig. 1, except that power factor corrective apparatus has been added. The scheme functions in the same manner and sequence as that shown in Fig. 1 until the motor is in step with the generator, and at this point the power factor corrective apparatus is caused to function. The corrective apparatus consists of a Le Blanc phase advancer driven by a small direct current motor, the speed of which may be varied to suit the power factor correction desired. The function of the phase advancer is somewhat similar to that of the direct current exciter in the case of the synchronous motor in that it supplies excitation to the induction motor. The connection is made to the secondary or rotor winding and thus excitation is supplied through the secondary instead of through the primary, with the result that the primary current is all "power" current, which means "unity" power factor.

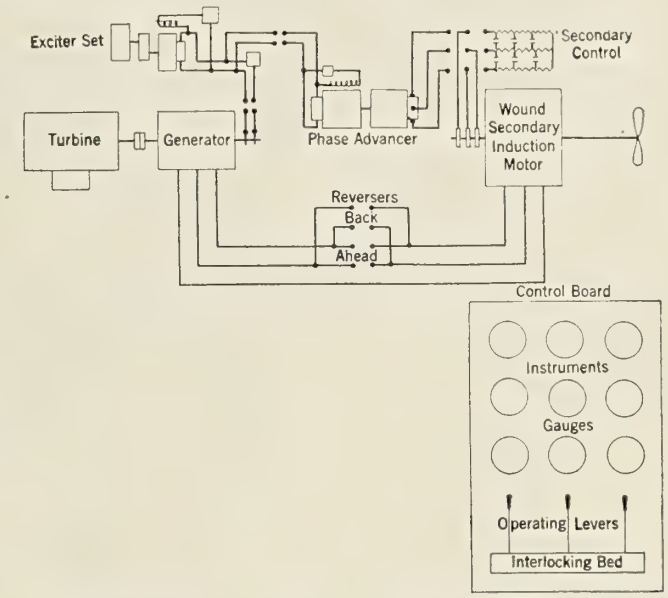


Fig. 4.—Diagrammatic Scheme of Connections for Wound-Secondary Induction-Motor Drive with Phase Advancer for Power Factor Correction

The phase advancer is a small commutating machine of very simple construction. The losses in the phase advancer consist of the internal copper loss due to the secondary current, almost negligible iron losses, friction, windage and brush drop. The total of these losses is very little and compares very favorably with the excitation power of the synchronous motor.

The induction motor used with this system is simple in construction, smaller, lighter and consequently less expensive than the motor used with the ordinary wound-secondary induction motor system. The generator is the same as that for the synchronous motor drive. Thus, the induction motor drive with the phase advancer not only provides the advantages resulting from unity power factor, but in addition provides the superior torque characteristics of the wound-secondary induction motor for maneuvering, and also obviates the necessity for synchronous operation with the generator. In fact, it combines all the desirable features and characteristics of both systems, without complications.

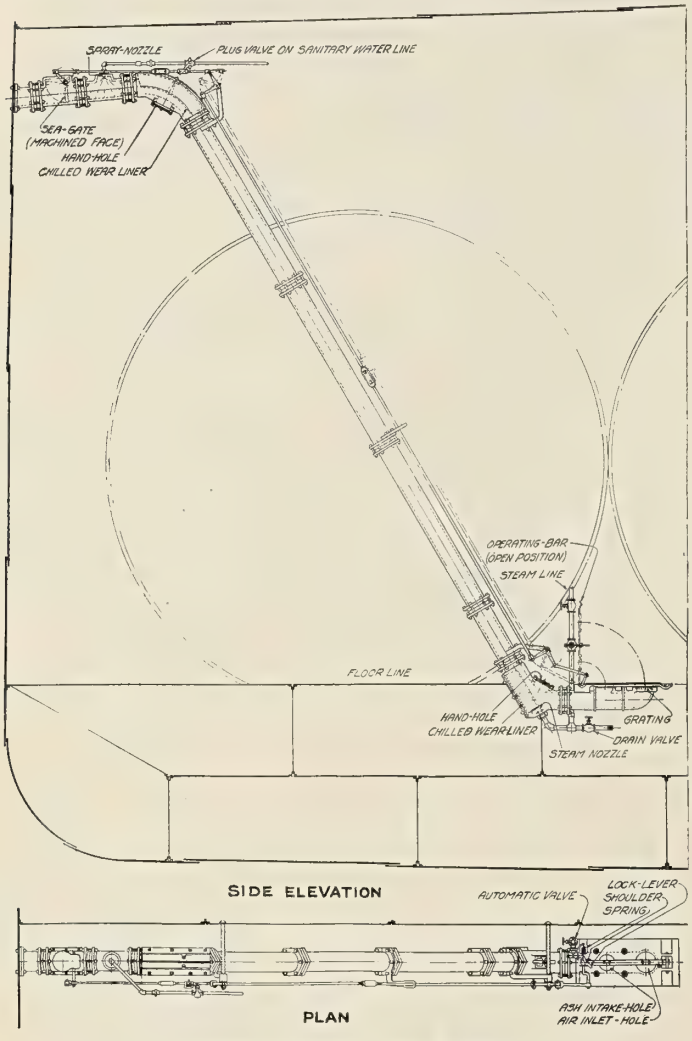
(*To be concluded*)

Ash Ejector Operates Without a Pump

AN ash ejector operated by specially designed steam nozzles was demonstrated at the Marine Exposition by the Victor Engineering Company, Philadelphia, Pa. The use of these nozzles makes pumps unnecessary for

ejecting ashes. The possibility of flooding the boiler room is eliminated and it is claimed that the loss of steam by the use of the system is reduced to a minimum.

The steam nozzle used is located in the lower elbow of the apparatus as indicated in the accompanying illustration. This nozzle directs a jet of steam through an inclined pipe,



Details of Victor Ash Ejector

thereby creating a suction in the horizontal part of the ejector located under the floor of the boiler room and a pressure as far up as the discharge end, which is located above the water-line. An automatic arrangement is provided for opening and shutting off the steam line so that the smallest possible steam jet will be required to create suction and pressure enough to allow the device to function properly. The nozzle itself is specially designed to give the maximum effect with a low steam consumption.

The different operations of turning on the steam, eliminating the dust, opening the sea gate and uncovering the ash intake—located flush with the floor—are combined in a single stroke of the operating bar. To reverse these operations it is only necessary to bring the bar back to a closed position.

Because of the fact that the size of the ash hopper has been reduced, it has been possible to keep it level with the floor so that ashes may be shoved directly into the hopper.

Air Compressors for Motorships

BULLETINS were distributed at the Marine Exposition by Albert Otto & Son, Inc., New York, describing Krupp single cylinder and double cylinder 3-stage high pressure air compressors which are now on the market in this country.

The single cylinder type K-C having a capacity of 230 cubic feet of free air per minute has a delivery pressure of 1,000 pounds per square inch when driven at 275 revolutions per minute. At this pressure 105 horsepower is required to drive the machine. The compressor is of the vertical enclosed box frame type having large bearing surfaces and a forced lubrication oiling system. The air is cooled at the various stages.

The type K-D two-cylinder machine has a normal capacity of 350 cubic feet of free air per minute delivering a pressure of 1,000 pounds per square inch when operating at 350 revolutions per minute. In this case 160 horsepower is required. In general the machine is similar to the type K-C.

Detecting Salt in Boiler Feed Water

TO overcome the reduction in steam power caused by the presence of salt in the boiler the McNab Company, Bridgeport, Conn., has developed a salt detector which will indicate the amount of salt entering the boiler through the feed line. When any sign of salinity is thus shown the engineer in charge is able to take precautionary measures against its entrance into the boilers.

Simplex Salt Detector

The McNab simplex salt detector is usually located in a convenient position in the engine room and connected by small copper tubing to the main feed line. Its operation is based upon the principle of the high electrical resistance of fresh water which is rapidly reduced when foreign compounds enter it. A meter is arranged within the salt detector which indicates the quantity of salt in grains per gallon that may pass through the feed line. In addition an incandescent lamp is arranged which will glow when as little as two grains of salt per gallon is present, the glow increasing to a bright light as the density of the solution increases. As a further warning an audible alarm is arranged within the detector which can be set to sound at any fixed percentage of salt density.

Insulation for Superheated Steam

IN order to secure the greatest benefit from the use of superheated steam, investigation of the subject indicates that increased care must be taken in providing proper insulation.

Bulletins distributed by the Magnesia Association of America at the Exposition outline the work of the research fellowship at the Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa., which has been carried on with the idea of making 85 percent magnesia pipe and boiler covering more efficient. As a result of this work, the association is insisting on thicker covering of superheated steam pipes, the latest specifications recommending double standard thickness 85 percent magnesia.

Substitutes for Natural Wood for Shipbuilding Purposes

By Horace Holden Thayer*

Continuation of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the various classes of workers in this field who have to deal with these materials from the materials point of view.

SUBSTITUTES for natural woods in shipbuilding are mainly of interest in connection with the joinerwork and may be divided into three general classes as follows:

(a) Composition Boards—composed of paper stock of various kinds, or similar materials, made up into sheets of the desired thickness.

(b) Plywood—composed of layers of thin wood or veneer glued together.

(c) A combination of wood and metal which we may call Flymetal—having a core or center layer of wood with thin metal surfaces cemented to it.

Steel partitions are used in place of wood joinerwork for boundary and division bulkheads of toilet and wash rooms and similar service where wood proves short lived or unsanitary; and also for galley bulkheads and other locations where a fireproof material is required; but they do not call for special consideration here.

The principal characteristics and uses of the three classes of materials above listed are:

Class (a) Composition Boards

Material of this class is of value on shipboard for panels that are to be painted. It cannot support loads and when in flat sheets has slight resistance to deformation. Some makes can be molded to curvature at the shipyard for ornamental arches between beams and similar service, while others can only be successfully thus handled at the point of manufacture. Some makes are built up on a cylinder, each revolution of which adds a layer of thickness, and thus they have a laminated structure like cardboard; while others are made of the desired thickness without this building up in layers. Some makes are given a special treatment to render the material sufficiently waterproof and some can be supplied either with or without special fire resisting properties, introduced by an impregnation treatment. Boards ¾ inch thick are built up by at least one of the manufacturers with a view toward their use as entire bulkheads but the writer does not consider this a field for products of this nature on shipboard that is likely to be successful. Full particulars regarding the particular nature and properties of any make can be obtained from the manufacturer.

For success with this material it is essential that it satisfy the following requirements:

To wear well.
To be reasonably waterproof.
To have freedom from bulging and not too great a tendency to warp.
To have slight expansion and contraction with changes of atmospheric conditions.
To be stiff enough to retain its shape whether flat or formed to a curve.
To have a smooth surface.
To take paint well.

A number of products of this nature have been placed upon the market from time to time and have failed to make good. Results of actual service on shipboard are the only safe guide to the selection of such material. The greater the experience of the manufacturer, the more uniform will be the product.

Having selected the material, great care is necessary in its installation. With the best products of this kind of which the writer is cognizant the following rules should be observed:

In order not to show crowning, panels should be at least ¼ inch thick, 5/16 inch is preferable and ⅜ inch is better still.

A solid T & G bulkhead backing is necessary for vertical panels ¼ inch or 5/16 inch thick and recommended for the ⅜ inch. The building of a complete bulkhead takes the place of the skeleton framework that would otherwise be required and also of the wood backing that is needed wherever furniture, fixtures, etc. are to be fastened to the panels. It also guards against injury to the panels from blows which would otherwise badly deface them.

The panels should be held in place in such manner that they will be free to expand and contract. In many cases the moldings around the edges will suffice, although a few finishing nails near the center are of advantage on large wall panels and should be used to support the weight of large overhead panels.

To prevent the possible buckling of the panels due to expansion about ⅜ inch should be allowed all around between the edge of the panel and the part of the molding against which it could seat itself. An attempt to butt panels edge to edge in order to produce the effect of a large flat surface will result disastrously unless carried out with great care and with ample provision against movement from expansion at the joint and ample provision for such movement elsewhere.

All wood backings and the inner surfaces of the panels should be painted.

Class (b)—Plywood

Material of this class is of value on shipboard for both painted and natural finish panels and also for entire bulkheads. This material when properly made is stronger and has greater resistance to deflection than a corresponding thickness of wood. It therefore does not require backing and, if desired, both sides of the panel can be exposed. For a painted surface the outside plies may be of any wood of suitable properties which will take paint well, such as gum, birch or poplar. For natural finish or so-called "bright work" the desired hardwood veneer is used and selected for color and beauty of grain.

Plywood can be readily molded to such curvature as before referred to and even to some extent to double curvature. Canoes have been molded out of a single sheet of it, the sides being fastened together at the bow and stern after molding.

For success with this material it is essential that it satisfy the following requirements:

The face veneers should be of high grade manufacture.
It should have an odd number of plies, or layers, of wood.
The center ply to be preferably of such material and thickness as to compensate for the strength in both directions of the layers adjacent to it and prevent distortion with changes in atmospheric conditions.
The side plies to be in pairs which exactly correspond as to properties of wood, thickness and direction of grain.
The grain of one ply to cross the grain of adjacent plies about at right angles.
The right kind of glue to be used, to insure against separation of the plies and blisters.
Where a bright finish is required, one or both faces, as may be necessary, should be of selected grain to give the desired appearance.

*Member of Rossell & Thayer, Naval Architects and Marine Engineers, Philadelphia, Pa.

The first requirement calls for careful attention because in the effort to speed up production the timbers are sometimes sliced by a loose cut method which produces a veneer the surface fibres of which are roughed up and injured. This results in a poor surface for finish and an increased tendency to check. Veneers produced in this manner can be readily detected by examination.

The writer has seen the results of an attempt to use a thin layer of a very soft, light weight wood as the center ply of some three ply material and found that the material not only warped badly but the surfaces checked badly.

The crossing of the grain at right angles operates against warping, tends to equalize the strength in both directions, reduces the shrinkage and enables the driving of nails near the edge of the material without danger of splitting. With regard to all of these points properly made plywood is far superior to ordinary wood.

The double diagonal sheathing between the planking and the frames of some types of large wood vessels, and the familiar double diagonal bulkheads, illustrate to some extent the valuable features of plywood.

For use as partitions on shipboard a thickness of 7/8 inch or more is desirable. Where the plywood is to be painted this can be satisfactorily obtained with a three-ply panel, although five-ply panels are preferable; but where expensive hardwoods are to be employed a five-ply construction is necessary, on account of the thinness of these veneers. Otherwise the center layer would be of disproportionate thickness and the strength along its grain would far exceed the strength across the grain of the two outside plies. Small panels can be as thin as 3/8 inch.

As with the materials of class (a) only well tried products should be used on shipboard.

Class (c)—Plymetal

The writer knows of only one product of this kind where the metal is applied to the wood in sheets, although there is another where the metal is sprayed on in fine particles which form a pure metal coating. The first mentioned product has been put on the market after careful tests by one of the successful manufacturers of plywood in sizes suitable for making up as ship's joiner bulkheads or partitions, with steel faces, galvanized or ungalvanized. For entire bulkheads 3/4 inch is a good thickness. Panels can be as thin as 5/16 inch. The faces are thin and offer little resistance to the cutting of the material, driving of screws, etc., and the use of metal eliminates all possibility of checking with consequent disfigurement of the paint coating. The material is of particular value in locations where its fire resistant features are an important consideration and of particular value also in locations where its sanitary and non-absorbent features are an important consideration.

This material is stronger and stiffer than the Class (b) material and very much stiffer than thin steel plates; it can therefore, like the plywood, be used without backing. For successful results it should satisfy the following requirements:

The wood core to be of the proper nature to adjust itself as far as necessary to the steel.

The cement to thoroughly bind the metal to the wood against all influence of moisture or inequalities of expansion due to changes in temperature.

The metal to be thin enough so that any necessary openings can be readily cut through the material.

This material, even when galvanized, requires an efficient paint coating to protect it from corrosion and all edges and other parts that are to be covered up should be thoroughly attended to as well as exposed surfaces.

Comparisons

The principal factors governing the selection of one class of these materials rather than another are the finish desired, the space taken up by the thickness of the completed partitions, the weight and the cost.

Finish

For bright finish work where solid boards are not to be used, plywood is essential. Imitations of some expensive woods can be readily obtained with cheaper grades of plywood and imitations of natural finish wood can be produced on plymetal.

For painted work the smooth, even, sanded surface of the plywood has an advantage although good results can be obtained with ungalvanized plymetal and with composition boards. Any checking of the plywood will mar the finish, whereas with plymetal the possibility of this does not have to be considered. Difficulties are experienced in obtaining a uniform surface in way of the fastenings of the composition boards and the effect is spoiled by any bulging or deformation of this material.

Relative Space

From the standpoint of space plymetal is at the head of the list with plywood a close second and composition boards at a decided disadvantage.

The question of space is of importance in connection with bulkheads between staterooms and in some cases is the determining factor in the selection of the material. In such locations the composition board construction must have a complete wood bulkhead or an even thicker skeleton construction, with a layer of the composition boards on each side of it. The question of space is of small importance overhead or in other locations where a single layer of the composition board would suffice.

Relative Weight

Weight is another important factor because the joinerwork is usually relatively high up and enters adversely into stability questions as well as questions of deadweight and earning power. Here the plywood as the lightest construction is on the whole at the head of the list with plymetal a close second and the composition boards again at a decided disadvantage.

With partition bulkheads the weight handicap of the composition board construction will be at least the entire weight of these boards, and greater where 1 1/8 inch wood backing is used.

Relative Cost

Costs are subject to considerable fluctuation which, while affecting all these products about the same from the labor point of view, do not necessarily affect them the same way from the materials point of view; so comparisons made at one time may not hold good at another. It can be safely figured, however, that for a properly constructed bulkhead the plywood for the same finish as the other products will again head the list as the lowest cost construction, with plymetal next and the composition board construction as the highest in cost. For siding and overhead ceiling the composition board construction without solid wood backing will be the cheapest.

Summary

Putting the foregoing in tabulated form with the most desirable construction under each heading mentioned first, we have:

Finish factor—Plywood, plymetal, composition boards.
Space factor for bulkheading (space elsewhere not being a factor)—Plymetal, plywood, composition boards.
Weight factor for bulkheading and siding—Plywood, plymetal, composition boards.
Weight factor for overhead work—Composition boards, plywood, plymetal.
Cost factor for bulkheading—Plywood, plymetal, composition boards.
Cost factor for siding and overhead work—Composition boards, plywood, plymetal.

Progress of Motorship Building in Europe

Development of Double Acting Diesel Engines—Large European Auxiliary Sailing Vessels—A 13,000-Ton Motorship

By Our Special London Correspondent

THERE is a strong undercurrent of opinion among British engineers that the ultimate development of the marine oil engine lies in the double acting type. There have been few signs of active progress in this direction during the past six or seven years but it is probable that when developments do occur on a commercial scale they will be extremely rapid.

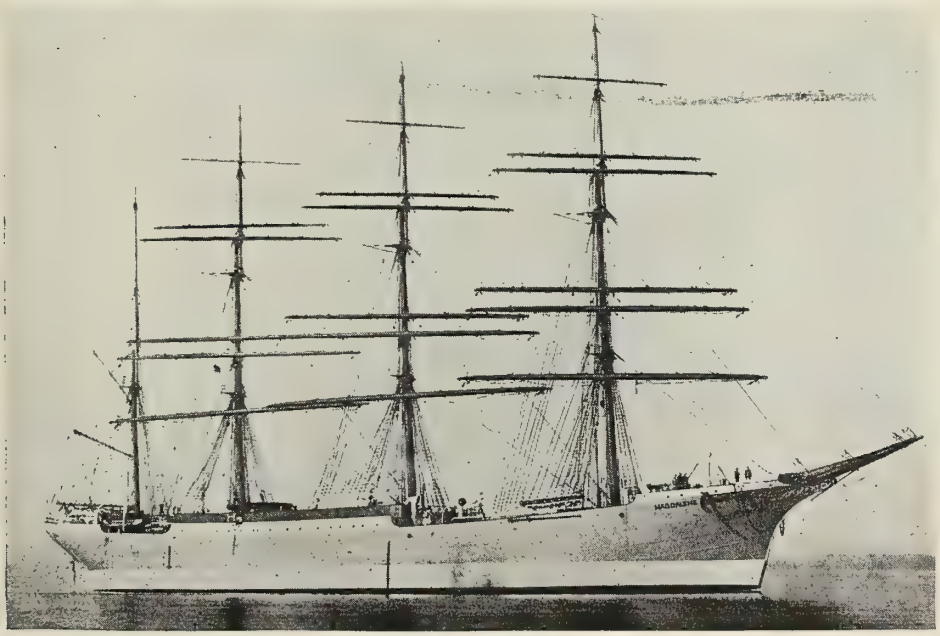
In Hamburg, Blohm and Voss are building some double acting engine motor vessels for the Hamburg American Line and in Great Britain much interest has been evinced in the double acting motor. In two of the largest oil engine building works, namely, Vickers and the North British Diesel Engine Works, experimental motors of this design have been constructed and it is specially significant to note that at the moment both of these firms are actually engaged upon the construction of four cycle single acting sets. In the case of the North British engine, a single cylinder experimental unit was built which developed about 600 brake horsepower and, although no announcement has been made, it is understood that the builders are satisfied with the design and will proceed to its standardized production in the course of a short time. In addition, Harland and Wolff, perhaps the largest builders of Diesel engines in the world, are engaged in an examination of the double acting engine so that within the course of the next year or two a vast change may come over the motorship situation.

The Kobenhavn, of 5,300 Tons, Fitted with a 600 Horsepower Burmeister & Wain Engine

The average European shipowner has not shown any strong disposition in favor of the large oil engined auxiliary and viewed with some suspicion the large program of construction of such vessels which was undertaken in the United States during the war. In certain quarters, however, there is an evident belief in ships of this class and, apart from an auxiliary built before the war, the two largest oil engined sailing vessels ever constructed have just been completed, one in Scotland and the other in Germany. The first boat is of special interest both from the technical and the shipowning standpoint. She has been constructed for the East Asiatic Company, for the dual purpose of trading in the ordinary way and training officers for the East Asiatic Company's large motor fleet.

The *Kobenhavn,* as the new ship is known, is designed to carry 5,300 tons of cargo and is provided with excellent accommodation for a large number of cadets. She is rigged as a five master and it is, rightly, thought that cadets trained in this vessel will gain a wider experience than is normally the case in a mechanically propelled craft, while the installation of Diesel engines will bring her right up to date in the matter of propelling plant. A 600 horsepower Burmeister and Wain engine is fitted and, under power alone, a speed of some 6½ knots will, it is anticipated, be maintained.

The *Kobenhavn* has just sailed on a maiden voyage round the world and has been followed almost immediately



The Magdalene Vinnen, of 5,200 Tons, Fitted with a 550 Brake Horsepower Krupp Diesel Engine

New Motor Passenger Liner Aba, Owned by the Elder Dempster Line

by the new German auxiliary *Magdalene Vinnen* with a deadweight capacity of 5,200 tons. She has been constructed solely as a cargo carrying ship and is equipped with a 550 brake horsepower Krupp engine of the four cycle type. As will be noted from the illustration, she is hardly so attractive a vessel as the *Kobenhavn,* which, incidentally, is provided with such refinements as motor driven winches for hoisting the sails and electric heating throughout the cabins.

Fresh Water Cooling for Diesel Engines

The motorship *Java* has just been delivered to the East Asiatic Company by Burmeister and Wain of Copenhagen and is the third ship of the same size built for this firm within the last year. All these vessels have a deadweight capacity of 13,300 tons and are equipped with machinery of exactly the same type as that installed in the United States Shipping Board motor vessel *William Penn.* Apart from the two Glen liners, the *Glenapp* and *Glenogle,* the *Java* and her sister ships are the largest motor craft yet completed.

The twin screw machinery is of the standard Burmeister and Wain type but it is of interest to engineers who have been concerned with the development of marine Diesel engines from the early days to note that in this vessel, as in the last few Burmeister and Wain productions, the cooling of the cylinders as well as the pistons is effected by means of fresh water. It is a highly debatable point whether fresh water cooling is more desirable than sea water, the contention of the advocates of the former system being that, if the vessel operates in shallow waters, there is always a danger of mud being forced through the pistons and cylinders. Hitherto Burmeister and Wain have only cooled the pistons with fresh water, utilizing sea water for the cylinders. They have now modified their ideas and use fresh water throughout, presumably basing this alteration on the experience obtained with ships equipped with their machinery. This involves the fitting of a large fresh water cooler in the engine room, and circulating sea water through it, thus involving an extra circulating pump.

For those who are interested in the fuel consumption of motor vessels, it is worth recording that a sister ship to the *Java* on her maiden voyage to Australia and back with an average speed of 12 knots had a fuel consumption of 14.1 tons daily and a lubricating oil consumption of 0.53 grammes per indicated horsepower hour including the lubrication of the cylinder as well as hand lubrication and waste in the forced lubricating oil system. The vessel carries an engine room staff of 14 men and has a draft, with full cargo, of 32 feet, the displacement being 19,000 tons.

The First Motor Passenger Liner

After many delays, the first motor passenger liner was completed at Harland and Wolff's Belfast yard and sailed on her maiden voyage early in November. This vessel, the *Aba,* owned by the Elder Dempster Line, is for the West African trade and is perhaps not so interesting a craft as the passenger liner *Domala* now approaching completion for the British India Steam Navigation Company. The *Aba* was built during the war as a pure cargo carrying ship and has now only been converted to a passenger liner, the machinery and hull otherwise remaining unaltered. A couple of Harland and Wolff engines are installed, developing about 6,000 indicated horsepower in all, and giving a speed in the neighborhood of 14 knots. Accommodation has been provided for 200 or 300 passengers, both first and second class, and in addition a fair amount of cargo is carried. The engines are not completely up-to-date as they are of the old independent cylinder unit system, which has since been modified in all Burmeister and Wain and Harland and Wolff designs.

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Hull of the Famous Schooner Yacht America, First Winner of the International Cup Which Bears Her Name. The America Is Now Stationed in the Naval Museum at the Naval Academy

The Motorship Malia

First Vessel Equipped with Camellaird Fullagar Engines

By A. P. Chalkley

IT is probably true to say that no marine oil engine has aroused so much interest among European and American shipowners and engineers as the Camellaird Fullagar type. The original design was developed by the late Mr. H. F. Fullagar, several years ago, and it was taken up and modified by Cammell Laird and Company, the well-known shipbuilders and engineers, while the war was in progress. Designs were prepared and shortly before the armistice, construction had commenced upon a Camellaird Fullagar submarine engine which it was believed would have proved lighter and more efficient than any previously known type. However, the war ended, and it was decided not to proceed with this development but the builders immediately commenced upon the construction of a commercial engine, suitable for installation in cargo ships.

As an indication of the attractiveness of the design, before a single installation was made, licenses for its manufacture were taken out by a large number of prominent shipbuilding firms in Great Britain and abroad, including John Brown and Company of Clydebank, Dunsmuir Jackson and Company and David Rowan and Company on the Clyde, Palmers Shipbuilding and Engineering Company on the Tyne, in addition to Japanese and French builders. Moreover, for stationary work a license was granted to Willans and Robinson who, for many years past, have been building their own type of Diesel motor.

Details of the Malia

The completion of the first ocean-going ship in which Camellaird Fullagar engines are installed was therefore a matter of considerable moment in the development of motorship construction. This vessel, the *Malia,* sailed on her maiden voyage in October, and it need hardly be said that her first trip to the East will be watched with close attention by all British shipowners interested in motorship development; and these comprise practically the whole of the shipowning interests in Great Britain.

The new ship has the following characteristics:

Length between perpendiculars	350 feet
Molded breadth	40 feet 4 inches.
Depth to upper deck	27 feet 3 inches.
Draft when loaded	23 feet.
Deadweight capacity	5,800 tons.
Shaft horsepower	1,100.
Speed, loaded, knots	9.

The *Malia* is a cargo vessel specially designed for the Eastern run and has been built by William Hamilton & Company, Ltd., Port Glasgow, to the order of T. and J. Brocklebank, Ltd., Liverpool, a concern having intimate connections with the Cunard Company which is known to be very definitely interested in the Cammell Laird engine and is credited with the intention of building a transatlantic liner equipped with this class of machinery.

Motorship Malia, Equipped with the First Cammellaird Fullagar Diesel Engines Ever Built

The unusual construction of the engines, which each develop 550 brake horsepower and have four cylinders with a bore of 14 inches, will be readily noted from the illustrations. A unit design is adopted, each unit comprising two cylinders cast together and having separate open ended liners. The lower piston in each cylinder drives direct on to a crank on the main crankshaft and each of the crossheads is coupled by means of two long diagonal rods to the crosshead of the top piston of the adjoining cylinder forming the unit.

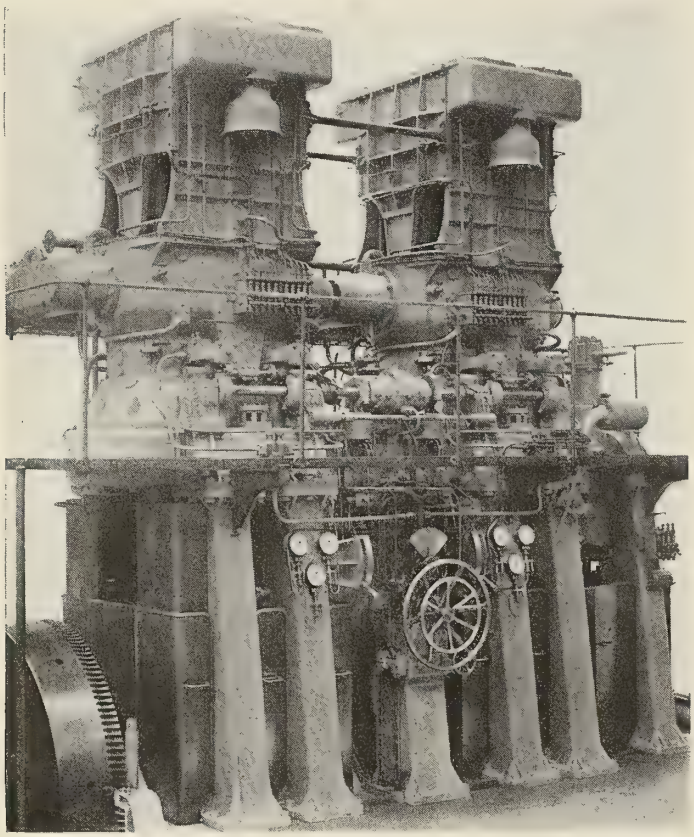
The great advantage claimed with this system as compared with other opposed piston designs is that there is only one crank for each cylinder and two crankshaft bearings for each pair of cylinders, since there is no bearing between the cranks corresponding to the two cylinders forming one unit. In the Doxford opposed piston engine, on the other hand, there are three cranks for each cylinder and, with the drive for the scavenging pump, there are 13 cranks in the shaft for a four-cylinder motor.

Valves

The engine is of course of the two-cycle single acting type and the scavenging ports are arranged at the bottom of the cylinder, with the exhaust ports at the top. A single fuel valve is provided for each cylinder, this being located hori-

zontally in the center of the liner and actuated in the usual manner from cams on the camshaft through the intermediary of valve levers. The other valves comprise a release valve and a starting valve for each cylinder, the latter being of the non-return type supplied from a mechanically operated starting valve, opened and closed during the starting period from cams on the camshaft.

Scavenging air is provided from a scavenging pump on the front of each cylinder, the top crosshead being rectangular in section and forming the piston of the scavenging pump. The adoption of rectangular pumps is something of a novelty but it is claimed that as a crosshead is needed in any case, the additional height required to form the scavenging pump on the top of the cylinder is practically negligible



One of the 550 Brake Horsepower Cammellaird Fullagar Engines Installed in the Malia

and floor space is thus saved besides which the cost of construction is reduced. The fuel pumps, of which there is one for each cylinder, are driven from two eccentrics on the camshaft and are arranged vertically below this.

Maneuvering

Maneuvering is effected by means of the large handwheel seen in the center of the engine. By turning it to the right or left, according to the direction of rotation required, air and fuel are put on all four cylinders so that the engine starts up on compressed air. After two or three revolutions the air is cut off two cylinders leaving two firing on oil and two running on compressed air. The remaining two are finally turned over to fuel alone by a continued rotation of the handwheel, the cycle of operation being indicated on the quadrant above the handwheel. The valves are set in the correct position for going astern by turning the handwheel in the opposite direction, causing the camshaft to turn to the requisite angle. To the right of the maneuvering wheel is seen a small hand lever which actuates the suction valves of the fuel pumps and thus increases or decreases the speed of rotation. To the left of the handwheel is a corresponding lever which alters the lift of the fuel valves according to the load on the engine.

Blast injection is employed and a three stage vertical air compressor is driven from a crank on an extension of the crankshaft. All the other auxiliaries, including the fresh water cooling pump and lubricating pumps, are driven by separate electric motors installed in the engine room. There are two lubricating oil pumps operated from 2-horsepower motors and the two fresh water cooling pumps are driven by 7-horsepower motors. The fresh water used for cooling the engine has itself to pass through a cooling tank around which sea water is circulated from a centrifugal pump driven by a 10-horsepower motor. Electric power is supplied from two semi-Diesel engines of the Vickers type driving 45-kilowatt dynamos, and to each of the same engines may be coupled a three stage air compressor, a clutch being provided for this purpose.

Trials

On trials the fuel consumption averaged about 0.42 pound per brake horsepower hour using Mexican Diesel oil of a specific gravity of 0.90. This corresponds to a daily fuel consumption of 4½ to 5 tons for a speed of nine knots when carrying 5,000 tons of cargo. It may be added that the mean effective pressure in these engines is high, working out at about 115 pounds (indicated) per square inch with the engine developing its full load. The scavenging air pressure under these conditions is 1.5 pounds per square inch and the blast injection pressure 850 pounds per square inch. The combined indicated horsepower of the two engines running at 125 revolutions per minute was about 1,570 or 1,100 brake horsepower. The average revolutions of both engines was 118, giving an indicated horsepower of 1,480, the speed of the ship being 10.7 knots.

Two engines of the same type, each of 1,000 brake horsepower, have been built and a 5,000 horsepower set of a similar design is under construction.

Bills Introduced in Congress

SENATOR JONES of Washington on November 4 introduced a number of bills relating to marine affairs in the Senate.

S. 2678 would require all ships sailing under a foreign flag and entering the ports of the United States or clearing therefrom to have a permit from the United States Shipping Board.

S. 2679 proposes to distribute the commissioned line and engineering officers in the Coast Guard in grades in the same proportions as provided by law for the distribution in grades of commissioned line officers of the Navy.

S. 2680 proposes to amend Section 4404 of the revised statutes of the United States to provide that the supervising inspectors of the steamboat inspection service be included under the classified Civil Service.

S. 2681 provides for giving a master of a ship of the United States the right to assert a claim against the vessel of which he is master for his wages and disbursements when the owners of the vessel are insolvent and the master would lose his claim if not permitted to assert it against the vessel.

Senator Fletcher on November 4 introduced in the Senate a bill, S. 2683, to amend the act to promote export trade by adding a provision that an association shall be deemed to be engaged in export trade for the purpose of this act if it shall promote agreements among its members as to the price and terms which shall govern the sale of their products to foreign customers engaged in trade promotion abroad, and generally promote such agreements and understandings among its members as are necessary to protect them from hurtful combinations and practices of foreign competitors or customers.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department

Conducted by James L. Bates

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Robertson's Curves

Q. (1140).—Referring to Mr. Alfred J. C. Robertson's paper before the Society of Naval Architects and Marine Engineers, in which he publishes certain curves derived from Admiral Taylor's experiments, you will note that all of the full line curves are for a displacement length coefficient of 160. I have not had the time to study the question as to just how he obtains results for displacement length coefficients other than 160. You will note that he has put in two dot and dash curves, one for 0.62 and the other for 0.78, both for a displacement length coefficient of 80. Please explain Robertson's method of figuring for this and other values between 80 and 160.

A. (1140).—The writer is not in a position to answer the above question absolutely inasmuch as he has not had an opportunity to discuss the matter with Mr. Robertson directly, but the following points are believed worthy of consideration:

In the first place, Mr. Robertson's work is intended primarily, if not entirely, for slow-going merchant vessels. For this class of ship the values of speed length ratio adopted rarely exceed 0.75 and are mostly between 0.5 and 0.65, also the values of displacement length coefficient, excepting for vessels of the greatest size in which draft limitation might force lower values, seldom fall below 150 or 160, also the draft ratio is pretty fairly constant, varying but little from 0.41, which Mr. Robertson has used on his chart. With these points in mind, I am of the opinion that Mr. Robertson did not intend to use other than a straight line method of interpolation for the effect of different values of displacement length coefficient.

Referring to the chart, it will be noted that the value of "C" varies only from 0.735 to 0.75 at a speed length ratio of 65 for a change in value of displacement length coefficient from 80 to 160.

The writer's experience with the use of Taylor's series would indicate that there is little error, even at considerably higher speed length ratios, in using this same straight line method of interpolation, but I rather think that Mr. Robertson included these dash and dot and dash curves more to give an idea as to the order of the effect of varying the displacement length coefficient than for actual use on this chart because, if you will note, he has only plotted them for the limiting values of prismatic coefficient, namely, 0.62 and 0.78.

Use of Special Steels in Ships' Hulls

Q. (1144).—What can you tell me of the use and arrangement of special steels in the hull structure of vessels in which great stresses are anticipated due to extreme proportions, to the disadvantageous location of heavy weights, or to a combination of both?

A. (1144).—High tensile steel has been used for the strength deck, sheer strake, keel and bottom plating of destroyers for some years. These vessels are designed with length to depth ratios as high as 17 and 18. They carry fuel oil amounting in some conditions of loading to as much as 25 percent of the displacement of the ship and distributed well toward its ends. Also in service they are subjected to large dynamic stresses resulting from being driven at high speed into head seas. Hence the necessity for high grade material advantageously disposed from the standpoint of longitudinal strength.

Modern light cruisers built for the British Navy are constructed with high tensile steel plating in the topmost strength decks and outer bottoms. This is for much the same reasons as already noted in the case of destroyers. In cruisers, however, the value of this material for protective purposes is an added argument for its fitting, particularly when, because of the size of the vessels and the correspondingly large stresses involved, the thicknesses required to secure adequate longitudinal strength are such as afford real protection to the ship's vitals except in the case of direct hits by major caliber shells.

High tensile steel was used amidships for a large part of the topside shell plating, for a considerable portion of the shelter and upper deck plating and for the main longitudinal bulkhead plating in the hold of the Cunard express liner *Lusitania*. In this case the classification society allowed a reduction of 10 percent in the scantlings as fixed upon a mild steel basis. It is of interest to note that in the case of the *Lusitania* the ratio of length to depth of strength girder is just over 12.

River steamers and other vessels of light hull structure in which the ratio of length to depth is excessive and in which the installation of heavy, powerful machinery rising through the strength deck permits the use of but very narrow continuous stringer plates may advantageously be fitted with a strength deck stringer and sheer strakes and bottom plating of high tensile steel throughout the ship's mid length.

In the cases referred to above, the maximum stresses estimated in accordance with the accepted methods are generally between seven and ten tons per square inch tensile based upon mild steel. High tensile steel is worked in the ship's longitudinal girder, either to secure greater strength for a given weight of structure or to secure a given strength for a smaller weight of structure than when mild steel is used exclusively.

The physical properties of high tensile and mild steel are as follows:

	High tensile	*Mild steel*
Tensile strength, pounds per square inch	80,000	60,000
Shearing strength, pounds per square inch	(about) 64,000	(about) 48,000
Elastic limit or yield point, pounds per square inch	45,000 to 60,000	35,000 to 40,000
Elongation, percent in 8 inches	20	25
Modulus of elasticy	30,000,000	30,000,000

The fore and aft extent of the high tensile steel worked usually varies from one-half to three-fifths the vessel's length. In cases where careful strength calculations are made and the resulting curve of bending moments shows that the greatest values are confined to a relatively small fore and aft extent, it may be possible to confine the high tensile steel to about three-eighths the vessel's length.

It will be noted that the modulus of elasticity has the same

value for both high tensile and mild steel. On this account the two materials work together satisfactorily under all ordinary conditions. However, it is considered important in vessels having high calculated stresses to use but one material (either all high tensile or all mild steel) at any given level, as a deck flat or bottom. The reason for this is that, if both high tensile and mild steel are fitted on same level and excessive strains are developed at that level so that the yield point of the mild steel is passed, the entire load will then be thrown into the adjacent high tensile steel. This may be sufficient to produce permanent set in, and perhaps finally rupture, the latter.

It is usually necessary to construct only the portions of the vessel farthest from the neutral axis of high tensile steel, because, the integrity of the structure being maintained, the stresses developed as the neutral axis is approached lessen rapidly. Frequently the bending moments due to hogging and sagging are so related that high tensile steel will be required in either the upper or the lower portion of the vessel only.

Either high tensile or medium steel rivets may be used in the joints between high tensile steel plates. The former are stronger when properly driven but are difficult to work satisfactorily. In calculating the strength of joints between high tensile steel plates, the following unit shearing strength for rivets in single shear may be used:

Medium steel rivets in high tensile steel plates	41,000
High tensile steel rivets in high tensile steel plates	64,000

Punching high tensile steel plates causes serious damage to the material. It is general practice to drill all rivet holes in this material.

See, also, Robinson's "Naval Construction"; "Practical Shipbuilding," by Campbell Holmes; "Structural Design of Warships," by Hovgaard; and "Warships," by Attwood.

Annual Meeting of Institution of Naval Architects

The annual meeting of the Institution of Naval Architects will be held in London on April 5, 1922.

CORRECTION.—In the description of the new ferryboats for Boston harbor, published on page 826 of our November issue, it was erroneously stated that the boilers were built by the Great Lakes Boiler Works, Buffalo, N. Y. These boilers were built by the Lake Erie Boiler Works, Buffalo, N. Y.

PERSONAL MENTION

CHARLES K. MALLORY of Syracuse, N. Y., has been appointed manager of the dry dock division of the surplus property department of the United States Shipping Board.

WILLIAM A. MCCARTHY has been appointed general agent for New York State for the American-Hawaiian Steamship Company's intercoastal service with headquarters at Rochester, N. Y.

E. L. FRIESE, formerly in charge of audits of the Globe Line, has been appointed by Harry Kimball, financial vice president of the United States Shipping Board Emergency Fleet Corporation, to have charge of collections.

W. H. BLASDALE has re-entered the employ of the Eastern Steamship Lines, Inc., as commercial agent, after three years with the coal interests at Pittsburgh. He was formerly the steamship company's general freight agent.

DANIEL H. COX, naval architect and secretary of the Society of Naval Architects and Marine Engineers, has been appointed special assistant to the chairman of the United States Shipping Board to act as liason officer between the Shipping Board and the American delegates to the Conference on the Limitation of Armaments.

H. SCHRECK, who for a number of years was associated with one of the leading shipyards in Germany in the early development of the Diesel engine and later was connected with the oil engine department of the Ingersoll-Rand Company, New York, has opened an office at 17 Battery Place, New York, with Messrs. Whittlesey and Whittlesey as a consulting marine engineer.

MORTIMER E. COOLEY, dean of the college of engineering and architecture of the University of Michigan, has been elected president of the American Engineering Council of the Federated American Engineering Societies. The new head of organized engineering is past president of the American Society of Mechanical Engineers. He graduated from the United States Naval Academy at Annapolis in 1878. After survey work on various assignments, he served in the drafting and design department of the Bureau of Steam Engineering until July, 1881, at which time he was detailed to the University of Michigan as a professor of steam engineering and shipbuilding. After four years at the university he was ordered to the Pacific station for duty, but resigned from the Navy to accept the chair of mechanical engineering. He served during the Spanish war as a chief engineer and for some time following was attached to the League Island Navy Yard. He has carried on a great amount of important appraisal work, including investigations of railways, telegraph lines, river improvements and the like in Michigan, Newfoundland, Wisconsin and many large cities throughout the country.

Dr. M. E. Cooley

GEORGE W. SMITH of Chicago has been made general western representative of the Black Diamond Steamship Company to succeed William S. Miller, resigned. He will handle the business of the company in Chicago in connection with its services from New York, Baltimore, Philadelphia, Boston and Hampton Roads to Rotterdam, Antwerp and Amsterdam. He was formerly foreign freight agent in the west for the Pennsylvania railroad.

OBITUARY

HOLLY MARSHALL BEAN, builder of 76 sailing vessels, died in Camden, Me., on November 9, aged eighty-seven. Mr. Bean was a director of the Coastwise Transportation Company and was for some years president of the Camden Yacht Building & Marine Railway, which he founded.

GARDINER G. DEERING, head of the shipbuilding firm of G. G. Deering Company, Bath, Me., and the oldest active shipbuilder in the country, with more than 100 vessels of various types and rigs to his credit, died on October 24, aged eighty-eight. Mr. Deering originated the idea of substituting stringers and braces for the old-fashioned knee formerly used in the construction of sailing vessels. Mr. Deering was for many years a director in the First National Bank of Bath and a member of the executive board of the Bath Trust Company.

Shipping and Ship Operation News

Changes in Steamship Routes — Passenger and Freight Activities—Port Plans and Other Notes of General Interest

Shipping to and from Virginia Ports Shows Decided Increase; Pier Expansion Likely for Next Year

Increase in Seagoing Traffic Affects Norfolk and Newport News—Port Commission Recommends Bond Issue of $5,000,000 for New Piers, Warehouses and Grain Elevators

SHIPPING to and from Hampton Roads is on the increase, according to statistics obtained by the Chamber of Commerce-Board of Trade, of Norfolk, Va. In the October report there was a total of 482 vessels or sixty more than were engaged in commerce during September.

There were thirty-two coal cargoes carried from this port in October. The increased number was due to the heavy demand for coal from Cuban and South American ports. The increase in seagoing traffic not only affected Norfolk but was noted in Newport News as well. More ships cleared from Hampton Roads than entered, the difference being 48.

Total tonnage entering and clearing from Hampton Roads during October was 1,410,164, against 1,290,543 in September, an increase of 120,621 tons. There were 165 entrances and 190 clearances from Norfolk last month, and Newport News reported 52 coming in and 75 going out.

American ships led in Norfolk entrances with 53, while only 48 Britishers came to the port. Norwegian vessels during the month totaled 24. The others were as follows: Dutch, 8; Danish, 5; Italian, 8; Japanese, 5; German, 3; Greek, 3; Spanish and Swedish, 2 each; Brazilian, Chilean, Belgian and Portuguese, 1 each. The largest number of ships entering was on the 24th, when 13 boats came in. One ship entered on the 8th and the 30th.

Sixty-four Britishers cleared from Norfolk during the month, against 41 American. Twenty-nine Norwegian crafts put to sea in October. Others were as follows: Dutch and Italian, 12 each; Swedish, 6; French, 5; Japanese, 10; German, 5; Danish, 5; Spanish and Greek, 2 each; Brazilian, Belgian and Chilean. Fifteen clearances on the 24th was the record for the month. Two ships cleared on the 27th, which was the smallest number in October.

Newport News reported a decided increase during the month of the volume of her shipping. Fifty-two ships entered and 75 departed. Nine American ships entered at the Newport News Customs House to 38 British ships. Other nationalities were: Norwegian and Dutch, 3 each; Swedish, Japanese, Italian and Spanish, 1 each.

Of the clearances, 52 were British and 11 American. There were 4 Norwegian and 3 Dutch steamers that cleared during the month. Other nationalities ranked as follows: Swedish, 2; Japanese, Italian, Czecho-Slovakian, and Spanish, 1 each.

Pier Developments

In connection with its recommendations for a bond issue of $5,000,000 for additional pier, warehouse and grain elevator facilities, the Port Commission has just made public a report on the very successful operation of the army base terminal leased by the city 22 months ago from the War Department. This report shows that all of the available space at the army base is now being utilized and that the lease has been profitable to the city and the Department.

Actual operation under the city's lease with the War Department began in December, 1919. Very little freight was handled, however, until February, 1920. The real beginning of business was marked by the movement of 100 tons of flour from the Pacific Coast, which arrived in February and March, and was shipped overseas before the end of June, 1920. Since that time there has been a consistent and substantial increase in business, varying with the seasons, as a large volume of the freight handled consists of cotton and tobacco.

Since December, 22 months ago, 351,373 tons of freight have been received and 307,273 tons forwarded. One hundred and fourteen ships called at the pier in 1920, and 102 have called this year to date.

The October business of the municipal terminal broke all previous records made by the city. Freight received during the month aggregated 21,146 tons, 14,995 tons were forwarded, and there was on hand October 31 a total of 49,016 tons of freight awaiting movement. For three weeks during October the average receipts were 100 cars per day, and for the remainder of the month receipts ranged from 50 to 60 cars per day.

For nearly a year now, the Port Commission has been making a careful study of the traffic possibilities and the needs of the port, and Council has asked the people for a vote on the question next January. These studies, based on the experience at the army base and the experience of other cities, have shown that public terminals can pay for themselves and yield some profit besides.

Notes of Interest to Steamship Operators

The West Coast Lumber Men's Association will hold a conference with the Massachusetts state authorities in Boston, Mass., in the near future, as a result of the meeting with John N. Cole, state commissioner of Public Works for Massachusetts, according to a report from Seattle, Wash. Massachusetts' proposed plan for a mammoth lumber terminal for East Boston connected with Seattle and other northwest lumber ports by fleets of steamships operating through the Panama Canal was disclosed by Commissioner Cole at the recent international port conference of the American Association of Port Authorities.

Representatives of commercial organizations and steamship lines operating from the principal American ports on the Pacific Coast have been informed that the United States Shipping Board would hold hearings at Washington, D. C., on Monday, December 14, with reference to the permanent assignment of the 502 and 535-foot combination cargo and passenger vessels of the trans-Pacific trade. The Board has seven of the 502 type vessels all of which have been delivered and of the sixteen 535 type vessels, ten of them delivered and six are scheduled for delivery between now and April.

Chairman Lasker, of the United States Shipping Board, has announced that as a result of a conference with the Secretary of War, the secretary turned over the remaining piers the War Department has in Hoboken and Brooklyn to the Shipping Board. These piers are No. 1 and 4 in Hoboken, and No. 4 in Brooklyn at the Brooklyn Army Base. This now gives the Shipping Board Piers 1, 2, 3, 4, 5, and 6 in Hoboken, and Piers 3 and 4 in Brooklyn Army Base, total of 34 berths. Chairman Lasker said: "In making pier charges the Government proposes to keep those charges up to sufficient height whereby a private pier owner will get a proper and ample return, but the Government will not aid in keeping up profiteering prices, and prices will average 3½ cents per net registered ton per day."

It is reported that the North German Lloyd plans an independent American service between New York and Bremen. It is planned to place three German steamships on this run. The service may possibly be extended to Baltimore next February.

A new service, to be known as the Blatt Line, has been established at Baltimore, to be operated by Seiler & Company, Vickers Building, Baltimore, Md. Two sailings monthly to Rotterdam, Hamburg and Bremen, will be maintained. The first vessel left Baltimore on November 3.

(Continued on page 946)

Shipbuilding and Shipyard Development

What the Shipyards Are Doing—Dry Dock Notes—Launchings—New Engineering Projects

Over $10,950,000 in Ship Work, Including Construction of Four Yachts, in Prospect for 1922

Outlook for Vessel Construction, Reconditioning and Equipment, in American Yards Shows Definite Signs of Improvement—Passenger, Freight and Pleasure Craft to Be Built

NEW ship construction and repair work in excess of $8,650,000 is in definite prospect for contract from the present time until well into the first six months of 1922, according to information obtained by MARINE ENGINEERING AND SHIPPING AGE. A portion of this sum includes several extensive ship reconditioning jobs—other than the *Leviathan*—which are expected to come out in the near future; over $2,000,000 is included for the construction of yachts and the balance will be taken up in the building of new freight and passenger ships, the preliminary steps for which are believed to have already been taken.

It is also interesting to note that there are now under construction in the shipyards of this country 581,385 tons of steel ships compared with 143,968 tons for 1914 and that an increase in new enterprises in the shipping industry was indicated during the month of October, 1921, by the formation of four companies with an authorized capital of $50,000 or greater, the total indicated investment being $7,550,000. This compares with $2,150,000 reported for September.

OUTLOOK FOR 1922

MARINE ENGINEERING AND SHIPPING AGE presents the information contained in this article as a substantial indication of better things for 1922. We are able to state definitely that, in addition to at least two new passenger and freight steamers, the construction of four seagoing yachts, varying in length from 165 to 238 feet—the latter craft having an estimated total cost of $2,000,000—is expected to be contracted for during the next few months. In view of the unusual character of the impending contracts and the priority of the data on hand, however, it is not deemed advisable to publish names at this time, although MARINE ENGINEERING AND SHIPPING AGE is enabled to present on absolute authority the facts given below as the "high spots" with regard to proposed new construction.

CONTRACTS PENDING

One steel yacht 238 feet long, oil burning, equipped with steam turbines and electric transmission. The engines are to develop 1,500 horsepower to drive the vessel at a speed of 15 knots.

One steel steam yacht, 225 feet in length, equipped with reciprocating engines and oil burners, to develop 1,200 horsepower and a speed of 14 knots.

A 192-foot yacht equipped with straight Diesel engines developing 750 horsepower to drive the vessel at the rate of 13 knots.

A 165-foot yacht equipped with Diesel engines developing 700 horsepower and driving the vessel at a speed of 13½ knots.

ADDITIONAL NEW WORK

C. V. S. Wyckoff, consulting engineer and naval architect of San Diego, Cal., and New York, reports that he has just been commissioned by the Champlain Company, of New York, to prepare complete plans for the construction of three sea-going cargo tow-boats, each of 1,500 tons capacity; twelve consort barges, each of 3,000 tons capacity, and one high speed supply and passenger boat of 200 tons capacity. The cost of construction of these vessels is estimated at $2,300,000, and it is expected that bids will be asked in about three months.

All the power driven craft will be designed on the combined "Arconstruc-Hullfin" principle which was first introduced in the ferryboat *Poughkeepsie*, now being built at the Mill Basin shipyard of the Atlantic Gulf & Pacific Company. They will have multiple units of Diesel-electric power, electric motors for driving the propellers, and pilot-house control. The entire fleet will have electric equipment throughout, each craft having dual generating sets.

NEW FERRIES

It is learned that the Department of Plant and Structures of the City of New York will soon have under way preliminary plans and specifications for the building of at least two new steel ferries, of the double ended type, for the East River. They will be about 170 feet in length and cost about $200,000 each. Bids will probably be asked for the latter part of January.

President Harding Will Request Congress to Grant Subsidies for American Merchant Marine

Would Secure One-Half of Immigrant Traffic for American Lines, Enforcement of Coastwise Laws Relating to Philippines, Abolition of Transport Service on Pacific and a Decision on Preferential Rail Rates

PROOF that definite action is to be taken to obtain our share of shipping in the near future is received as we go to press. The fact that a special commission has been functioning for the last ten days with the object of determining the amount of subsidy that is necessary for the various trade routes shows that the President favors and will advocate this form of Government aid for shipping. The commission will prepare a definite concrete plan which the President announces will be sent to Congress with a special message within six weeks.

The members of the commission are as follows: Professor Emory R. Johnson, University of Pennsylvania; Winthrop L. Marvin, vice-president and general manager of the American Steamship Owners' Association; Rear-Admiral H. H. Rosseau, U. S. N.; Rear-Admiral Clarence S. Williams, U. S. N.; Daniel H. Cox, of Cox and Stevens; Grosvenor M. Jones, author of a monograph on "Government Aid to Merchant Shipping," and Norman Beecher of the Admiralty staff of the Shipping Board's counsel.

FEATURES OF PLAN

It is understood that among those measures to be recommended are:

1. The requirement that 50 percent of all aliens, admitted under the 3 percent restricted immigration laws, be forced to book passage on American-flag ships.

2. That the coastwise laws be extended to the Philippines on February 1, 1922.

3. That the Army and Navy transport services on the Pacific be discontinued and this traffic be turned over to private interests.

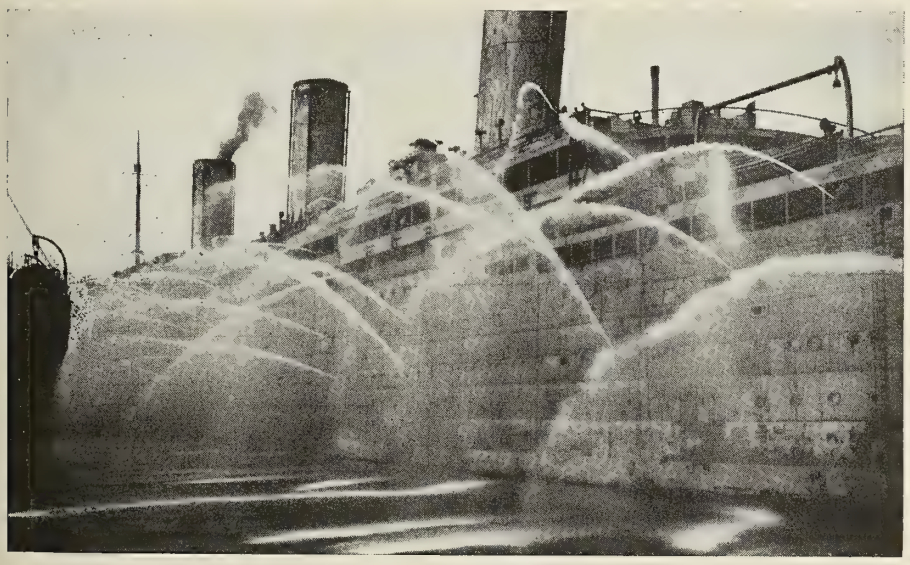
4. That hearings be held to determine the advisability of putting in effect Section 28, which restricts the railroads in granting export rates to shipments of commodities to be shipped on American vessels.

Specifications for Reconditioning The Leviathan Set New High Mark in American Engineering Accomplishment

William F. Gibbs and Construction Department Staff of International Mercantile Marine Company Complete Gigantic Task—Ship to Be Ready for Sea in 1923

BIDS for reconditioning the steamship *Leviathan*, which is looked upon as the biggest repair job in American history, are scheduled for opening about December 29, the general conditions and requirements to be completed by March 15, 1923, providing the contract is awarded not later than January 15, 1922. If the contract is awarded later than January 15, 1922, fourteen months will be allowed to complete the work.

The task of preparing the detailed specifications, which are in twelve volumes in addition to two volumes of photographs and a large number of blue prints, has been successfully accomplished by the construction department of the International Mercantile Marine Company under the control of William Francis Gibbs. The completion of the plans and specifications is looked upon as a masterful stroke of marine engineering. Considerable credit is being given Mr. Gibbs, who has carried out the work in the face of much adverse criticism, and his efforts are regarded as another sample of the results obtainable when someone says "It can't be done."



Fire Test on Leviathan.

Begun in 1919.

Preparation of detailed specifications for reconditioning the *Leviathan* was begun by Mr. Gibbs and his department in December 1919. In April, 1920, the specifications were in shape to submit to shipbuilders for bids. The Shipping Board, however, was undecided about letting the contract, and work was temporarily stopped. In April, 1921, it was decided to complete the outline plans for the vessel and to revise the former specifications. This work was finally finished early in November and specifications issued in pamphlet form for bids. The two volumes of plates included with the specifications give all necessary designs for interior decorations, furniture, clocks, lamps, electric light fixtures, fans and other accessories for staterooms, saloons, smoking rooms, restaurants and the like. About forty detail drawings of the ship, necessary to give prospective bidders a comprehensive outline of the work involved, are also included. Drawings are made to 1/16 scale and include an inboard profile of the vessel as she will appear when reconditioned; complete deck plans, giving the location of all spaces, furniture, layout for cabins, saloons, restaurants, etc.; details of all bulkhead changes to be made, these last having been approved by the American Bureau of Shipping; equipment details for such apparatus as fresh and salt water heating systems; arrangement of fresh water tanks; oil fuel system arrangement, oil fuel line expansion joint details; heating coils for fuel oil tanks; oil fuel filling and overflow systems, approved by the American Bureau of Shipping; fuel oil transfer system; ballast system in the boiler rooms and forward and aft spaces; bilge piping diagrams; return heating coils; smothering lines in oil tanks; layout of boiler room floors; burners for the fuel oil system; arrangement of pipes in the pipe tunnel; ventilating details; drains, condensers, pumps, etc.

For the convenience of prospective bidders, the specifications are divided into twelve volumes, covering various subjects as follows:

Title Subjects.

Title No. 1 deals with the general conditions and requirements; Title No. 2, oil fuel installation; Title No. 3, joiner work, interior finish and decoration, furniture, furnishings, miscellaneous equipment, etc.; Title No. 4, galleys and pantries; Title No 5, air ports, side lights, doors, ports and hatches; Title No. 6, electrical installations, this volume probably being one of the most technical of its kind ever published; Title No. 7, plumbing, sanitary and fire extinguisher systems; Title No. 8, deck, floor and plumbing drains; Title No. 9, steam heating; Title No. 10, ventilation; Title No. 11, top sides; Title No. 12, lifeboats, their handling and stowage gear, this title provides for the equipment of the ship with lifeboat capacity for 4,750 persons.

In addition to general drawings prepared for bids, a staff of about sixty draftsmen is busy preparing detail drawings for actual construction which will be available for the use of the company to which the contract is awarded. The scope of the work of getting out the specifications may be understood from the fact that about seventy-five draftsmen were occupied on them the greater part of the time since last spring when the matter came up for settlement.

SAN BENITO'S RECORD

Cyclone Fails to Stop Electrically Propelled Fruit Ship

The United Fruit Company's new cargo carrier *San Benito*, the largest electrically propelled freighter built and equipped abroad, arrived in New York October 24, on her maiden voyage from Almeria, Spain, after a hard tussle with cyclonic seas. For 24 consecutive hours she was tossed about in the worst storm that Captain J. C. Jackson of the vessel has experienced in his 29 years at sea, but she reached port in perfect condition so far as her equipment was concerned.

Among the 28 passengers on the *San Benito* were W. McClelland, director of electrical engineering of the British Admiralty, and his deputy, S. D. Constable. Both were elated on the success of the trip. "Never saw anything more reliable in my life than this electric drive," said Mr. McClelland.

The *San Benito* is a new ship and this was her maiden voyage. She was built by Workman, Clark & Company of Belfast, for the United Fruit Line. She has a tonnage of 5,500, is 336 feet long, has a beam of 45 feet and was designed for a speed of 12.5 knots. Her electrical equipment, built and installed by the British Thomson Houston Company, Ltd., consists of a 2,040 kilowatt Curtis turbine generator, driving a 3,000 horsepower synchronous motor attached to the propeller. The motor is set in the stern, thus eliminating the shaft tunnel and shafting and adding considerable to the cargo space. Her circulating pumps, forced air draft and ventilating system are also electrically operated.

On her trip she maintained an average speed of 10.5 knots, considered remarkably well for the weather encountered, and made a maximum speed of 15.1 knots. She left the shipyards at Belfast on September 20 and cleared Almeria with a cargo of onions, figs and grapes on October 10. She will be sent to Boston where she will be placed in service to the West Indies.

133 Steel Vessels Building and Contracted For in the United States; 126 Are For Private Ownership

Seagoing steel tonnage under construction and contracted for, according to yards, as indicated in the latest bulletin issued by the American Bureau of Shipping, is as follows:

Steel Tonnage Building and Contracted for in the United States, November 1, 1921

Shipyard	Private Account No.	Private Account Gross	Emergency Fleet No.	Emergency Fleet Gross	Total No.	Total Gross
Bethlehem S. B. Corp., Ltd.						
Baltimore D. D. Plant	2	11,600	..	.....	2	11,600
Harlan Plant	1	1,462	..	.....	1	1,462
Sparrow's Point	3	40,500	3	31,500	6	72,000
Union Plant	5	48,000	..	.....	5	48,000
Daniels, Oscar, Co	1	7,800	..	.....	1	7,800
Federal S. B. Co	3	18,000	..	.....	3	18,000
Fuller, Geo. A., Co	1	6,121	..	.....	1	6,121
Hanlon D. D. & S. B. Co.	1	1,500	..	.....	1	1,500
Los Angeles S. B. Co	..	.....	1	7,300	1	7,300
Merchant S. B. Corp	3	21,850	..	.....	3	21,850
Moore S. B. Corp	2	10,250	..	.....	2	10,250
N. Y. Harbor D. D. Co	2	6,570	..	.....	2	6,570
New York S. B. Corp	4	27,400	3	31,500	7	58,900
Southwestern S. B. Co	2	10,388	..	.....	2	10,388
Standard S. B. Corp	1	5,600	..	.....	1	5,600
Sun S. B. Corp	4	35,066	..	.....	4	35,066
Texas S. S. Co	1	6,700	..	.....	1	6,700
Union Const. Co	4	23,800	..	.....	4	23,800
Union S. B. Co	6	40,800	..	.....	6	40,800
Virginia S. B. Corp	1	6,060	..	.....	1	6,060
Total	47	329,467	7	70,300	54	399,767
China	..	.....	1	7,000	1	7,000

River and Harbor Steel Tonnage Building and Contracted for in the United States for Private Owners, November 1, 1921

Shipyard	No.	Gross	Shipyard	No.	Gross
American Bridge Co	22	7,953	Marietta Mfg. Co	6	2,550
American Car & Foundry Co.	3	1,500	Merchant S. B. Corp	1	250
Bethlehem S. B. Co. (Balt. D. D. Plant)	1	488	Midland Barge Co	2	170
Consolidated S. B. Corp	3	2,575	Nashville Bridge Co	1	258
Doullut & Williams	3	1,350	New Jersey D. D. & S. B. Co.	4	2,694
*Dravo Contracting Co	8	950	Rice Bros	4	1,600
Eichleay, John, & Co	4	540	Spedden S. B. Co	1	325
Federal S. B. Co	3	3,600	Standard S. B. Corp	1	250
Johnson Iron Works	2	700	Staten Island S. B. Co	2	2,260
Kyle & Purdy	4	3,590	Ward, Chas., Eng	3	1,350
Lawley, Geo	1	350	Total	79	35,303

*Dravo Contracting Co. also have contract with U. S. S. B. for three steel barges.

SALE OF SHIPS

20 Vessels to Be Offered If Diesel Drive Is Installed

Admiral W. S. Benson, Commissioner of the United States Shipping Board, in Charge of Construction and Machinery Efficiency, has issued the following announcement:

"The United States Shipping Board has long recognized the prime necessity of developing Diesel engine driven tonnage if this country is to take its rightful place as a maritime nation.

"The Board has determined today to offer for sale 20 of its vessels to purchasers who will agree under bond, or other satisfactory guarantee, to the installation of full Diesel propelling machinery in such vessels. At present days' costs, this installation in a 10,000-ton vessel will amount to around one-half million dollars. Sales of Diesel tonnage have been made abroad as low as $60.00 but the going rate today is probably nearer $80.00. The Board is prepared to sell for cash the above tonnage to the highest bidder who guarantees immediate installation of types of machinery to be approved by the Board on such a basis as to make this offer an attractive one.

"It is the unanimous opinion of the Board that in this action it is carrying out three important provisions of the Merchant Marine Act. First, placing of its tonnage in private hands; second, providing the most modern type of vessel for service under the American flag, and, third, giving work to American shipyards at a time when their business is at very low ebb."

FIVE ELECTRIC BOATS

New York Engineer Preparing Plans for New Craft

Plans and specifications for five new packets to ply between New York and Buffalo will be under way next week by R. R. Livingston, Marine Engineer, of 2 Rector Street, New York City, according to official information obtained by MARINE ENGINEERING AND SHIPPING AGE. The boats will be equipped with Diesel electric drive, and it is believed the total cost will be close to half a million dollars.

Preliminary figures place the length of the packets at about 160 feet with a carrying capacity of 500 tons each. There will be two Diesel engines, driving generators, and two motors, driving twin propellers. The power plant of each boat will develop about 260 horsepower.

It is understood that the five boats are to be completed by May, 1922.

Trial Trip of the Dixie Arrow

The *Dixie Arrow*, built for the Standard Transportation Company at the plant of the New York Shipbuilding Corporation, Camden, N. J., left the yard on its trial trip November 23, 1921.

The overall dimensions of the ship are 485 feet in length, beam 62 feet 6 inches, and depth 39 feet 6 inches. She is equipped with three single end Scotch main boilers and one 3,200 indicated horsepower engine of the four cylinder, quadruple expansion, four crank, direct acting, surface condensing type. This engine is capable of propelling the vessel loaded to the specified draft at a speed of 11 knots. The vessel will have ten double main cargo tanks with a combined capacity of 3,500,000 United States gallons. It has a displacement of 18,277 tons and carries a crew of 62 men.

Libraries Planned for Every American Ship

With the slogan "A Library for Every American Ship," the American Merchant Marine Library Association has taken over for American merchantmen in peace-time the work carried on by the American Library Association during the war in supplying good reading matter to the men at sea. The association is perfecting plans for placing a library of from eighty to one hundred books on every American merchant ship for the use of the sailors and officers.

The headquarters of the association are at 82 Beaver Street, New York, with Miss M. M. Barkley, formerly of the Social Service Bureau, in charge, and Arthur H. Battey, a New York newspaper man, formerly news editor of MARINE ENGINEERING AND SHIPPING AGE, serving as agent of the organization.

Shipping Board Transactions Involving Millions Result in Action Against C. W. Morse

Following an investigation into the transactions of Charles W. Morse with the United States Shipping Board, Fletcher Dobyns, special assistant to the Attorney-General, will present the evidence before the Federal Grand Jury, it was announced from Washington. According to testimony of witnesses before the Walsh Committee, millions of dollars in excess of what had been contracted for were paid over to the Morse interests, including $3,000,000 advanced to the Groton Iron Works, after the plant had been in receivers' hands, in order to lift this court action. It is claimed that materials which had been purchased for the construction of ships had been used by the Morse companies for other construction. It is also alleged that loans under mortgage carrying false representation were negotiated.

Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Recondition Motorship, San Francisco, Cal.—Two new tail shafts are being made for the motorship Lassen, which is in dry dock at the yard of Barnes & Tibbitts.

To Purchase Tugs, Coos Bay, Oregon.—It is reported that the steady increase of business may necessitate the purchase of a seagoing tug and a smaller tug for business inside the harbor. The port commission is negotiating for a big tug in New York and for a smaller one with local firms.

Will Purchase Trawler, Port Hawkesbury, N. S.—It is learned that the Leonards Fisheries, Ltd., will purchase at once another trawler to replace the trawler Baleine, which has become a total wreck and has been abandoned by her owners and underwriters.

To Convert Subchaser Into Yacht, Philadelphia, Pa.—Henry A. Hitner's Sons have sold the subchaser No. 71 to C. A. Cromwell, after having purchased the vessel from the Government at a price of $1,250. The vessel will be renamed the Nomad, and will be converted into a yacht.

Pump Contract Award, Brooklyn, N. Y.—James Shewan & Son has been awarded a contract for installing a new circulating pump on the electric drive ship Archer and preparing the vessel for sea. The ship is operated by the Barber Line and it is expected she will leave shortly for the Far East.

Large Repair Contract, Seattle Wash.—The Todd Dry Docks, Inc., has been awarded the contract for repairing the freighter Arizonan, which struck a ledge off San Juan Island, October 4. The company's bid amounted to $42,900, the work to be completed within twenty-five days. A number of plates of the vessel will have to be replaced.

Ship Repairs, San Francisco, Cal.—The steam schooner Thomas Rolph is at the yard of Barnes & Tibbitts having boilers and machinery installed. This vessel was recently bought by George E. Billings. The steam schooner Oregon, of Wilson Brothers & Company, is also on the ways of the plant receiving a new tailshaft.

Large Repair Job Bids In, San Francisco, Cal.—According to a report from San Francisco the United Engineering Company, with a price of $189,300, was low bidder on the contract for reconditioning the Matson Navigation Company's steamer Lurline. The bid is still under consideration, but is said to be far below any others.

New Lightship Contemplated, Aberdeen, Wash.—Great satisfaction is expressed by marine men over an appropriation of $400,000 for a modern lightship for Grays Harbor, and it is the general opinion that the bill stands a good chance of being passed, as such a vessel has been a basic need of the port for many years and would mean a great stimulation of cargo trade.

Tugboat, San Francisco, Cal.—The Enterprise Engine Company was awarded the contract for the installation of engines in the new inspection and tugboat to be constructed for the State Harbor Board, and which is being designed by D. W. and R. Z. Dickie, engineers and naval architects, San Francisco. The vessel will be 57 feet in length, 14 feet beam and 6 feet depth, and will cost $25,000.

Repair Contracts Awarded, Oakland, Cal.—The Moore Shipyards have been awarded the contract for installing a new low pressure cylinder on the steamer Oriental, which sustained damages on her maiden voyage from Shanghai to San Francisco. The bid was $8,850. The company was also awarded the contract for plate repairs on the Pacific Mail liner Golden State on a bid of $2,378. On the east coast the Baltimore Shipbuilding Company, Baltimore, Md., was awarded a contract by the Shipping Board to repair the steamer West Arrow at a cost of $2,481.

Engine Contract Award, New York.—The Hooven, Owen Rentschler Company, New York City, has been awarded a contract for two 2,000 horsepower engines which are to be installed in the steamship San Jacinto, which is now undergoing a general overhauling at the yard of the Tietjen & Lang Company, Hoboken, N. J. The engines will be 23-39-66 by 42-inch stroke, and it is understood the contract involves about one hundred thousand dollars.

Fireboat, New York.—Trials of the new fireboat John Purroy Mitchel, built for the city of New York by the Standard Shipbuilding Corporation, have been successfully completed on the Hudson River. The boat ran a true mean speed of 14.29 knots and a practice run with the tide of 15.72 knots. The contract speed was 12 statute miles an hour. The boat will be inspected by the Fire Department before it is taken over by the city in the near future.

Repairing Steamer, Brooklyn, N. Y.—The contract for dry docking and miscellaneous repairs to the steamship Livingston Roe, of the Standard Oil Company of New Jersey, has been awarded to the Robins Dry Dock & Repair Company, of the Todd Shipyards Corporation, at a price of approximately $6,700. Other competitors for the work were the W. & A. Fletcher Company, $7,520; the Morse Dry Dock & Repair Company, $7,740, and the Staten Island Shipbuilding Company, $8,600.

Contract Awards, Hoboken, N. J.—The Tietjen & Lang Dry Dock Company has been awarded a contract for repairs to the steamship Finland of the International Mercantile Marine Company. The steamship H. M. Flagler, of the Standard Oil Company of New Jersey, and the steamship Hampden, of the United American Lines, have been awarded to the W. & A. Fletcher Company, Hoboken, N. J., for various repairs.

Admiral Steamers Reconditioning, San Francisco, Cal.—The passenger steamer Queen will be repaired and overhauled, the work requiring about three months. The steamer Admiral Rodman, recently damaged by fire, will also be repaired. These steamers being laid up necessitated the revision of the schedules of the entire coastwise fleet of the Admiral Line, and the rearrangement has been carried out, according to H. S. Eaton, assistant manager at San Francisco.

Shipbuilding Activities at Seattle, Wash.—Indicative of activity in shipping circles, the Harbor Island plant of the Todd Dry Dock, Inc., at Seattle, Wash., has increased its force from 500 to 800 men. In addition to its usual business the Todd Company is fulfilling three repair contracts for trans-Pacific vessels, aggregating $100,000. Todd builders are now converting the Puget Sound Navigation Company's steamship Whatcom into a ferryboat at a cost of approximately $100,000.

Ferryboat Contract Award, Alameda, Cal.—The James Robertson Shipyard has been awarded a contract for the construction of the first ferryboat of the Golden Gate Ferry Company. The work on the boat will be rushed and it is expected the vessel will be ready for operation by next May. Construction of the slips and wharves for the boat will be started on January 1. According to plans of the company a second ferryboat will be constructed later.

Improving Steerage Accommodations, Hoboken, N. J.—Improvement of steerage passenger accommodations and engine repairs are included in the work to be done on the steamships George Washington and American Legion, the contracts for which have been awarded to the Tietjen & Lang Dry Dock Company by the Shipping Board.

Yacht to Be Reconditioned, City Island, New York.—The Robert Jacob Shipyard has been awarded a contract for general overhauling and installation of new engines in the yacht Sabalo by the Tams, Lemoine & Crane Company, 52 Pine street, New York. Two Winton Diesel engines, direct drive, of 300 horsepower each will be installed. It was estimated that the contract will cost close to $50,000.

Awards to Fletcher Company, Hoboken, N. J.—The W. & A. Fletcher Company has been awarded the contract for reconditioning the United Fruit steamship Heredia, now lying at New Orleans, La. The work to be done on this ship is extensive and includes the laying of new wooden decks, repairing considerable hull damage as a result of collision, dry docking, renewal of canvas boat deck, renewing portions of insulations, renewing tank top insulation, reconditioning of refrigeration system and machinery and local repairs.

Equipment Orders Placed, New York.—The Augusta, Gardiner & Boothbay Steamboat Company, 283 Water street, Augusta, Maine, has placed an order with the Kearfott Engineering Company, Inc., 95 Liberty street, for new machinery for their river boat Virginia. It is understood that an order for export has been placed with the same company for engine and boiler room equipment for a tugboat. The boat is quite similar to the 100-foot harbor tugs built in this country for the Shipping Board.

Steamship to Be Reconditioned, New York.—Specifications are expected to be ready for distribution about December 15 for reconditioning the steamship Manchuria, of the International Mercantile Marine Company, 9 Broadway, New York. It is believed the contract will involve the expenditure of about a quarter of a million dollars and it will probably be awarded about Christmas time. It is understood the work consists chiefly of converting the third class quarters to 75 per cent closed accommodations and the balance into open accommodations and general voyage repairs.

Fireboats, Philadelphia, Pa.—Another fireboat will be added to Philadelphia's harbor fire fighting fleet in 1922, according to official information obtained by Marine Engineering and Shipping Age. The city now has under construction two oil burning fireboats, one of which will be delivered the latter part of this month and the second will be delivered the early part of January. Messrs. Cornell & Matthews, marine engineers, have supervised construction of these boats.

We are advised by Director James T. Cortelyou, of the Department of Public Safety, Philadelphia, that the city "will probably purchase a third oil burning fireboat some time during the coming year."

Ferryboats, New York. — It was announced that bids for the construction of three electric drive ferryboats for the Department of Plants and Structures of the city of New York, previously reported, will be advertised for by December 1, with bid openings about December 20.

The municipal ferryboat Mayor Gaynor, of New York, is expected to be taken from service about December 1, dry docked and preparations made for the installation, about December 17, of a new Babcock & Wilcox boiler. Bids will probably be asked for two new propellers for the steamer, at a cost of about $2,500. The total cost of the work on the boat will be close to $50,000.

Steamship Reconditioning, New York.—One of the largest repair jobs for the closing of 1921 is anticipated for the near future when plans and specifications will be completed by Tams, Lemoine & Crane, naval architects, 52 Pine street, New York, for the extensive reconditioning of the steamship Relay, of the All America Cable Company. A survey of the ship is now being made preparatory to the drawing up of the plans and specifications. Although details are not yet available as to the full extent of the work, it is stated that two new Scotch boilers will be installed. Definite announcement of the opening date of bids will probably be made by the naval architects within the next two weeks.

Steamer to Be Converted, New York.—It is reported that specifications are in course of preparation for the extensive reconditioning of the Munson Line steamship Walter D. Munson, and that bids may be asked for within the next two or three weeks, the total cost of the job being estimated at a quarter of a million dollars. The work, if carried out as contemplated, is said to include the conversion of the ship into a passenger and freight steamer.

CONSTRUCTION FOR NAVY

Vessels under construction for United States Navy and their degree of completion as reported October 31, 1921, by the Bureau of Construction and Repair, Washington, D. C., are as follows:

Type Number and Name	Contractor	Percent of Completion Nov. 1, 1921 Total
BATTLESHIPS (BB)		
45 Colorado	New York S. B. Corpn.	83.0
47 Washington	New York S. B. Corpn.	69.8
48 West Virginia	Newport News S. B. & D. D. Co.	64.0
49 South Dakota	New York Navy Yard	35.2
50 Indiana	New York Navy Yard	33.2
51 Montana	Mare Island Navy Yard	27.6
52 North Carolina	Norfolk Navy Yard	36.7
53 Iowa	Newport News S. B. & D. D. Co.	29.9
54 Massachusetts	Beth. S. B. Corpn. (Fore River)	10.4
BATTLE CRUISERS (CC)		
1 Lexington	Beth. S. B. Corpn. (Fore River)	26.7
2 Constellation	Newport News S. B. & D. D. Co.	15.5
3 Saratoga	New York S. B. Corpn.	29.4
4 Ranger	Newport News S. B. & D. D. Co.	2.9
5 Constitution	Philadelphia Navy Yard	11.7
6 United States	Philadelphia Navy Yard	11.1
SCOUT CRUISERS (LIGHT CRUISERS) (CL)		
4 Omaha	Todd D. D. & Const. Corpn.	96.8
5 Milwaukee	Todd D. D. & Const. Corpn.	93.7
6 Cincinnati	Todd D. D. & Const. Corpn.	87.4
7 Raleigh	Beth. S. B. Corpn. (Fore River)	63.7
8 Detroit	Beth. S. B. Corpn. (Fore River)	71.6
9 Richmond	Wm. Cramp & Sons Co.	78.
10 Concord	Wm. Cramp & Sons Co.	71.
11 Trenton	Wm. Cramp & Sons Co.	52.
12 Marblehead	Wm. Cramp & Sons Co.	47.
13 Memphis	Wm. Cramp & Sons Co.	40.
AUXILIARIES		
Repair Ship No. 1, Medusa (AR1)	Puget Sound Navy Yard	70.6
Dest. Tender No. 3, Dobbin (AD3)	Philadelphia Navy Yard	66.4
Dest. Tender No. 4, Whitney (AD4)	Boston Navy Yard	36.8
Sub. Tender No. 3, Holland (AS3)	Puget Sound Navy Yard	21.5
Aircraft Tender, Wright (AZ1)	Tietjen & Lang	96.
PATROL VESSELS		
Gunboat No. 22, Tulsa (PG22)	Charleston Navy Yard	71.1
Authorized but not under construction or contract: (1) Transport No. 2.		
DESTROYERS		
338 Wasmuth	Mare Island Navy Yard	99.7
339 Trever	Mare Island Navy Yard	97.7
(a) 340 Perry	Mare Island Navy Yard	79.5
(b) 341 Decatur	Mare Island Navy Yard	73.7
Destroyers authorized but not under construction or contract: (12) Nos. 348 to 359 inclusive.		
SUBMARINES		
115 S-10	Portsmouth, N. H., Navy Yard	94.6
116 S-11	Portsmouth, N. H., Navy Yard	92.1
117 S-12	Portsmouth, N. H., Navy Yard	91.
118 S-13 (c)	Portsmouth, N. H., Navy Yard	89.6
123 S-18	Electric Boat Co. (Quincy)	97.
124 S-19	Electric Boat Co. (Quincy)	96.5
125 S-20	Electric Boat Co. (Quincy)	98.5
126 S-21	Electric Boat Co. (Quincy)	94.9
127 S-22	Electric Boat Co. (Quincy)	95.8
128 S-23	Electric Boat Co. (Quincy)	94.
129 S-24	Electric Boat Co. (Quincy)	93.
130 S-25	Electric Boat Co. (Quincy)	93.5
131 S-26	Eleteric Boat Co. (Quincy)	92.4
132 S-27	Electric Boat Co. (Quincy)	91.
133 S-28	Electric Boat Co. (Quincy)	91.6
134 S-29	Electric Boat Co. (Quincy)	90.5
136 S-31	Electric Boat Co. (San Fran.)	97.6
137 S-32	Electric Boat Co. (San Fran.)	96.
138 S-33	Electric Boat Co. (San Fran.)	99.2
139 S-34	Electric Boat Co. (San Fran.)	95.4
140 S-35	Electric Boat Co. (San Fran.)	92.8
141 S-36	Electric Boat Co. (San Fran.)	90.3
142 S-37	Electric Boat Co. (San Fran.)	88.1
143 S-38	Electric Boat Co. (San Fran.)	82.4
144 S-39	Electric Boat Co. (San Fran.)	79.8
145 S-40	Electric Boat Co. (San Fran.)	78.6
146 S-41	Electric Boat Co. (San Fran.)	79.7
153 S-42	Electric Boat Co. (Quincy)	76.3
154 S-43	Electric Boat Co. (Quincy)	76.9
155 S-44	Electric Boat Co. (Quincy)	74.9
156 S-45	Electric Boat Co. (Quincy)	75.4
157 S-46	Electric Boat Co. (Quincy)	74.
158 S-47	Electric Boat Co. (Quincy)	73.2
159 S-48	Lake T. B. Co. (Bridgeport)	98.
160 S-49	Lake T. B. Co. (Bridgeport)	96.
161 S-50	Lake T. B. Co. (Bridgeport)	92.1
162 S-51	Lake T. B. Co. (Bridgeport)	89.8
FLEET SUBMARINES		
60 T-2 (SF 2)	Electric Boat Co. (Quincy)	99.3
163 V-1 (SF 4)	Portsmouth, N. H., Navy Yard	6.3
164 V-2 (SF 5)	Portsmouth, N. H., Navy Yard	4.9
165 V-3 (SF 6)	Portsmouth, N. H., Navy Yard	4.8
Note: Submarines authorized but not under construction or contract: Fleet Submarines (6) Nos. 166 to 171. Neff Submarine (1) No. 108.		

(a) Destroyer 340, Perry, launched October 29, 1921.
(b) Destroyer 341, Decatur, launched October 29, 1921.
(c) Submarine 118, S-13, launched October 20, 1921.

Tietjen & Lang Contracts, Hoboken, N. J.—The Tietjen & Lang Dry Dock Company has been awarded the contract for repairing damage as a result of a fire in the hold of the Southern Pacific steamship El Alba, at an estimated cost of $6,400. The same yard has also been awarded the Cylde Line steamship Huron for the repair of damage as a result of going ashore in the south, costing about $6,000; and the New England Navigation Company steamer Mohegan and a New York Central car float which were in collision recently in the East River. The steamer sustained damage to her stem, the contract in this case involving about $3,500 and for the car float about $2,500.

New Steamer, Charleston, W. Va.—The Charles Ward Engineering Works has been awarded a contract for the construction of a stern wheel shallow draft steamer for use in southern waters by the Mexican Petroleum Company. The vessel will be 136 feet over all in length, 34 feet beam and 5½ feet deep. She will be equipped with high pressure steam engines with 18-inch cylinders and 7-foot stroke, developing about 700 horsepower. The boilers will be equipped with four oil burners. The boat was designed by Cox & Stevens, naval architects, 15 William street, New York.

Centennial State Awarded, Hoboken, N. J.—The W. & A. Fletcher Company was awarded the contract for reconditioning the Shipping Board steamer Centennial State. The work consists chiefly of reconditioning the third class quarters, making new staircases and enlarging old staircases, general voyage repairs and overhauling of piping, radiators and electrical work. The bids were as follows: W. & A. Fletcher Company, $17,085; Standard Shipbuilding Corporation, $19,247; Tietjen & Lang Dry Dock Company, $19,412; Morse Dry Dock & Repair Company, $20,500.

New Freight and Passenger Vessels, Baltimore, Md.—Supplementing the announcement carried exclusively on August 27, 1921, Marine Engineering and Shipping Age is advised that the Merchants & Miners Transportation Company is taking preliminary steps toward getting out plans and specifications for a combination freight and passenger steamship. Although no details are available at present, it is believed the proposed ship will be built of steel, approximately 350 feet in length, and will cost close to $1,000,000. It is understood that definite decision as to whether the ship will be coal or oil burning is still pending. Mr. A. D. Stebbins is president and general manager of the transportation company.

Steamer Repairs, Hoboken, N. J.—The contract for reconditioning the Clyde Line steamship Lenape has been awarded to the Tietjen & Lang Dry Dock Company on a bid of $124,000 and twenty-eight days. The bids submitted were as follows:

Tietjen & Lang Dry Dock Co.	$124,000	28 days
Morse Dry Dock & Repair Co.	113,500	45 days
Robins Dry Dock & Repair Co.	128,600	36 days
W. & A. Fletcher Company	169,000	72 days
Alderton Dry Dock Co.	151,000	55 days
Federal Shipbuilding Co.	226,900	90 days

The Tietjen & Lang yard was also awarded a contract for repairs to the Cylde Line steamship Apache, which was damaged in collision at sea recently with the schooner Singleton Palmer. The repairs will cost about $9,000.

Ferryboats, Chester, Pa.—The Sun Shipbuilding Company has been awarded a contract for the construction of two ferryboats for the Pennsylvania Railroad Company for use between Camden, N. J., and Philadelphia, Pa. Both vessels and equipment were designed by the Pennsylvania Railroad Company, and will be completed in about six months, the total cost being estimated at close to half a million dollars.

The boats will be 168 feet in length over guards 55 feet beam, and 14 feet 8 inches deep. They will have six transverse watertight bulkheads, a 111-foot 6-inch cabin, and will be equipped with three-cylinder compound engines 18 by 26 by 26 by 22 inches stroke, driving two four-blade propeller wheels 8 feet 2 inches diameter with 12 feet 6 inches pitch. Two Babcock & Wilcox watertube boilers having 3,300 square feet of heating surface and 22 square feet of grate surface will be installed. The boats will use coal for fuel and the engines will develop about 800 horsepower. It is expected the steamers will be completed by the summer of 1922.

Hull Repairs, Brooklyn, N. Y.—The Clinton Dry Docks Company was awarded the contract for general hull repairs for the steamer Patrol, a service boat of the Department of Plant and Structures of the City of New York. The work includes the renewal of 84 plates, 31 frames, renewal of keelson 12 lineal feet, 200 square feet of hull plate renewal for patches, etc., renewal of five additional frames, 10 feet additional on keelson, 50 keel rivets, 100 rudder rivets and tap bolts, 500 hull rivets and 250 feet of calking. The total bids submitted were as follows: Clinton Dry Docks, $13,509; Robins Dry Dock & Repair Co., $15,870; Standard Shipbuilding Corp., $17,065.50; Jas. Shewan & Sons, $20,383; Lord Dry Dock Company, $23,358; National Dry Dock & Repair Co., $24,114; New York Harbor Dry Dock Co., $25,789; Theo. Crane & Son, $28,156; Ira Bushey & Son, $31,436; J. W. Sullivan, $37,153; Federal Shipbuilding Co., $37,442.50.

Big Repair Job, Chester, Pa.—The Merchant Shipbuilding Corporation has been awarded a contract for reconditioning the United American Line steamships Franklin and Fairmont, bids for the former being opened at noon on October 26. The principal item covered in the specifications was the installation of a new deck on the Franklin, with special provisions to be considered for doing similar work on the Fairmont. It is believed that the total amount involved for the two ships will be close to $100,000. The bids covering the Franklin were as follows:

Name of Yard	Wood Deck	No. of Days	Steel Deck	No. of Days
Merchant Ship'ing Corp.	$55,500	..	$58,000	52
Federal Ship'ing Co.	59,000	36	75,000	42
Standard Ship'ing Corp.	63,000	..	66,000	60
New York Harbor Dry Dock Co.	63,081	..	67,729	49
Bethlehem Ship'ing Corp.	64,600	48	60,657	30
Staten Island Ship'ing Co.	66,500	..	74,200	..
Newport News Ship'ing Co.	72,200	35	80,700	40
W. & A. Fletcher Co.	74,065	60	86,635	65
James Shewan & Son	79,000	..	86,500	38
Morse Dry Dock & Repair Co.	80,000	40	89,000	50
Tietjen & Lang Dry Dock Co.	89,770	..	91,690	45
Robins Dry Dock & Repair Co.	92,800	..	99,800	45
Sun Shipbuilding Co.	109,500	..	107,900	45
Theo. Cranes' Sons	145,982	..	154,892	56

It was announced that steel decks will be installed.

Steamer Repairs, Hoboken, N. J.—The Clyde Line steamships Algiers and Algonquin have been awarded to the W. & A. Fletcher Company for dry docking and various repairs. The same yard was also awarded the tanker J. A. Bostwick, of the Standard Oil Company of New Jersey, for general repairs, on a bid of $4,300, and the steamship Maumi, of the Foreign Transport & Mercantile Company, of New York, for dry docking and miscellaneous repairs, at a price of about $3,500.

The company has also been awarded a contract for repairs to the steamship Joseph Seep, of the Standard Oil Company of New Jersey, at a price of $6,200. The work consists of dry docking, drawing tail shaft, hull repairs and cargo system and machinery overhauling. The same company was also awarded the steamship Acropolis, of the Stephen Stephanidis Company, 24 State street, New York, for dry docking and repair of hull damage at a cost of about $3,000.

SHIPYARDS AND DRY DOCKS

May Buy Western Shipbuilding Plant, San Pedro, Cal.—It is reported that J. J. Tynan, manager of the Union plant of the Bethlehem Shipbuilding Corporation at San Francisco, Cal., is in the east conferring with Charles M. Schwab and others regarding the probable purchase of the plant of the Southwestern Shipbuilding Company.

Company Formed to Build Dry Dock, North Vancouver, B. C.—The Burrard Dry Dock Company, Ltd., was recently incorporated with a capital of $1,000,000 by Clarence Wallace, John J. Coughlan and Robert C. Lennie, to build a floating dry dock at Vancouver Harbor. Slips, work shops, machinery, piers, etc., will be included in the project, and when completed the company will carry on a general shipbuilding and repair business.

Purchase Plant, San Francisco, Cal.—It is announced by George A. Armes, president of the General Engineering Company, that his concern has purchased the holdings of the Triangle Engineering Company, all of the equipment of which will be installed at the plant of the General Engineering Company, which will be considerably enlarged to accomodate the additional equipment. The firm formerly operated under the name of Mooney & Young, but with the appointment of Mr. Armes as president and a partner, decision was made to change the name to General Engineering Company.

PORT IMPROVEMENTS

Terminals, New Bern, N. C.—The Board of Aldermen contemplates the construction of a municipal terminal at Union Point with dock facilities and railroad track connections.

Wharf Extension, Halifax, N. S.—The Commercial Cable Company plans an extension to its wharf at Halifax. A description of the site and plans have been sent to the Department of Public Works at Ottawa.

Recreation Pier, Brooklyn, N. Y.—The Department of Docks & Ferries, Pier A, North River, New York, plans a recreation pier at Coney Island, requiring 1,700,000 cubic yards of sand fill, 5,120,000 b. m. feet of timber, 110,000 tons of rock and 4,000 reinforced concrete piles.

Equipment for Freight Shed, Tacoma, Wash.—The Port Commission will construct a new freight transit shed on the water front, to be equipped with the latest freight handling, conveying, hoisting equipment, etc. The estimated cost of the project is $500,000.

Dredging, New Jersey.—The contract for dredging the section for the proposed inland waterways connecting Barnegat Bay with the Manasquan River, has been awarded to L. B. Harrison, Market Island, Paterson, N. J., by the Board of Commerce and Navigation, Trenton. The bid was $.245 per cubic yard.

Removal of Wreck, Philadelphia, Pa.—Contract for the removal of the wreck of the steamship Katahdin, sunk in Philadelphia harbor, has been awarded the Merritt & Chapman Wrecking Company of Philadelphia, Pa., on its bid of $24,066. According to specifications the derelict must be removed within eight months.

Docks, Etc., Miami, Fla.—The City Commissioners contemplate building an addition to the permanent pier and also a temporary dock for loading lumber on numerous small vessels. The city plans to sell $300,000 bonds, and that, with the $100,000 already on hand, will make $400,000 available for this construction work. Charles W. Murray is city engineer.

Channel, Miami, Fla.—The Bakers Haulover District, of which J. C. Baile is chairman, contemplates the construction and maintenance of a cut 200 feet wide and 1,200 feet long, between the Atlantic Ocean and Biscayne Bay, according to plans by the War Department, and to cost approximately $300,000. Hobart Crabtree is temporary engineer.

Dredging, Manitowoc, Wis.—The City, Z. Zaneler, clerk, is having plans prepared for dredging the Manitowoc River and making harbor and channel improvements to cost about $30,000. F. Alter, City Hall, is engineer. It is reported that the Reiss Coal Company and the Manitowoc Shipbuilding Company will appropriate toward the cost of this project.

Cold Storage Plant and Docks, Los Angeles, Cal.—President Weaver, of the Los Angeles Chamber of Commerce, and officers of the California Fruit Growers' Exchange, have laid plans for a cold storage plant and shipping docks before the harbor commission, San Pedro, Cal., and have been assured of the board's full co-operation. More than $500,000 will be spent for the construction of docks and providing equipment for the handling of the fruit.

Docks and Terminal, Philadelphia, Pa.—The Philadelphia and Reading Railroad, Reading Terminal, is having preliminary plans prepared by M. Baker, architect, Reading Terminal, Philadelphia, for a two-story terminal and docks of reinforced concrete and steel to have concrete pile and wood pile foundation, at Kaighns avenue, Camden, N. J., for railroad and ferries. The estimated cost of the project is $2,000,000.

Piers Destroyed by Fire, Weehawken, N. J.—At a recent fire the piers of the Erie Railroad Company at the foot of Baldwin avenue were burned. Piers A, B, C and D, a three-story warehouse, four lighters and forty-eight freight cars filled with merchandise were destroyed before the flames were under control. About twenty barges, belonging to the Erie Railroad, which were lying between the piers were damaged. The loss is estimated at from $1,500,000 to $2,000,000.

Extensive Harbor Improvements, San Francisco, Cal.—According to Miss Hilda Gohrman, secretary of the Board of State Harbor Commissioners, plans for extensive harbor developments representing an expenditure of more than $2,500,000 are being pushed to completion in order to afford relief locally and give employment to hundreds of men. Plans and specifications for the $2,500,000 warehouse to be erected at Barry and Second streets are nearing completion and bids are expected to be called for within a few weeks.

Large Port Project, Grays Harbor, Wash.—According to latest reports a large port terminal will be erected at Grays Harbor, according to present specifications now under consideration by the port commission. The dredging of one 28-foot channel below Hoquiam is included in the work to be carried out. The Grays Harbor Construction Company has the contract for constructing the first wharf unit and transit shed at an estimated cost of $141,760. The wharf will be 800 feet in length and 300 feet wide and will have a warehouse erected upon it.

GOVERNMENT WORK

Radio Tower, Eureka, Cal.—Specification 4533. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a 300-foot radio tower.

Radio Tower, Keyport, Wash.—Specification 4538. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a 200-foot radio tower.

Repairs to Radio Quarters, North Truro, Mass.—Specification 4532. The Bureau of Yards and Docks, Navy Department, Washington, D. C., will have repairs made to the radio quarters.

Repairs to Barracks, Norfolk, Va.—Specification 4535. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans repairs to the Marine Barracks, No. 2.

Radio Quarters, Amagansett, N. Y.—Specification 4536. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans radio quarters.

Deferrization Plant, Annapolis, Md.—Specification 4539. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a deferrization plant.

Refrigerating Equipment, San Diego, Cal.—Specification 4543. The Bureau of Yards and Docks, Navy Department, Washington, D. C., will install cold storage and refrigerator equipment at the Naval Hospital.

Lubricants.—Schedule 115. The Marine Corps, Quartermaster's Department, Washington, D. C., is in the market for 15,000 pounds of cup grease and 7,000 pounds of transmission gear lubricant to be delivered to Post Quartermaster, Quantico, Va., Paris Island, S. C., and Hampton Roads, Va. Further information may be obtained upon application.

NEW INCORPORATIONS

The Port Jefferson Shipyard Corporation, Port Jefferson, L. I., has been incorporated with a capital of $1,000,000 to operate a shipbuilding and repair plant. The Delaware Registration Trust Company, 900 Market street, Wilmington, Del., are representatives of the company.

The International Ferry, Ltd., Sarnia, Ont., has been incorporated under the Dominion Companies Act with an authorized capital of $200,000 to operate a ferry service, for automobiles, passengers and conveyances of all kinds, between Sarnia, Ont., and Port Huron, Mich., and to carry on a general navigation and steamship business. The incorporators include G. C. Stevenson, Port Huron, Mich., and N. L. LeSueur.

The Mackenzie Basin Fisheries, Ltd., Calgary, Alta., has been incorporated under the Dominion Companies Act with a capital of $200,000, to carry on a general fishing and fur business and to operate ships for transportation of freight and passengers. The incorporators include C. J. Ford, L. H. Miller, G. A. Costigan, Miss M. Acton, and G. Kirkpatrick, Calgary, Alta.

The Twin Submersible Salvage Company, Portland, Maine, has been incorporated with a capital of $10,000,000 to engage in the business of salvaging, recovering, reclaiming, restoring, etc., disabled, sunken or submerged boats, ships, etc., build bridges, piers, dams, etc., dredging, operate towboats, vessels and do all things incident.

Hind, Rolph & Company, Inc., San Francisco, Cal., has been incorporated with a capital of $250,000 to build and operate vessels of all kinds.

The Tri-National Steamship Corporation, Dover, Del., has been incorporated with a capital of $4,000,000 to own and operate boats.

The International Salvage Corporation, Wilmington, Del., has been incorporated with a capital of $200,000 to engage in the business of salvaging and raising sunken vessels.

FOREIGN ACTIVITIES

Port Improvements at West Africa.—Official Government reports received at Washington, D. C., state that an extensive program of construction and improvement of railways and port works is planned for Angola, a Portuguese West African possession, including the building of port works at Benguela Velha, Santo Antonio do Zaire, Porte Alexandre, Saco, Geraul, Bero and Mossamedes, enlargement of the present harbors at Loanda and Lobito, a new railway for Benguela Velha to the Amboim coffee district and the extension of the Mossamedes Railway.

Trial Trip of Axpe Mendi, Stockton-on-Tees, Eng.—The steamship Axpe Mendi, built by the Ropner Shipbuilding & Repairing Company, Ltd., Stockton-on-Tees, recently made her official trial trip, which was reported as very satisfactory. The steamer was built to the account of the Compania Naviera Sota & Aznar, of Bilbao, Spain, and to Lloyd's classification, 100 A-1, and to the British Board of Trade. She is a vessel of about 6,035 tons.

Motorship Lobos, Greenock, Scotland.—The motorship Lobos, a twin screw vessel built by Harland & Wolff, Ltd., in their Greenock shipyard for the Pacific Steam Navigation Company, had a very successful trial trip. The vessel, which is classed 100 A-1 at Lloyd's, is 419 feet long, 54 feet broad, 35 feet 3 inches deep, with a gross tonnage of 6,479, and is the first cargo vessel built in Greenock propelled by Diesel engines. The vessel is designed to maintain a mean speed of 11½ knots.

To Improve Harbor, Leghorn, Italy.—The Italian Government has approved plans for the extension of the harbor of Leghorn, whereby its capacity will be doubled and a canal 12 miles long will be constructed, thus connecting Pisa with the sea.

Naples Harbor Improvement, Italy.—The present congestion at Naples again brings to the fore the proposed port improvements which were under consideration just before the war, and the Government as well as two Italian steamship companies now plan to make such improvements, according to recent reports from Italy. Three large piers are contemplated from the present Molo San Gennaro to be equipped as a freight and passenger terminal, giving easy access to the hotel section of the city, the piers to have complete railway connections, mostly underground. The piers and warehouses will cost approximately 65,000,000 lire. Another project contemplated includes the widening of the present Nolo Orientale by 50 meters and the construction of six warehouses of 28,800 square meters floor space, this undertaking to cost 40,000,000 lire.

Waterways, Antwerp, Belgium.—The Antwerp port authorities will soon resume the improvement and extension of the Dutch-Belgium waterways, which were commenced prior to the war. The river Meuse is to be deepened, and a new canal is to be constructed between Antwerp and Moerdyk. A lateral canal will also be constructed on Dutch territory to Maasbracht, giving Maestricht access to foreign shipping, and linking the latter city by a lockless canal with Liege and the Kempen mines, while only two locks would separate it from the Rhine, one from Brussels and five from Antwerp.

Fleet Addition, Spain.—According to a recent announcement the Ybarra Line will soon add to its fleet three new vessels of 5,000 tons each, namely, the Cabo Rocha, Cabo Tinoso and Cabo de las Heurtas. The company maintains a cargo service between the United States and Spanish ports.

May Have Motor Fleet, Gothenberg, Sweden.—The Transatlantic Steamship Company, of Gothenberg, has been granted a license by the Swedish Government to sell two of its steamers, each of about 8,000 or 9,000 tons deadweight. This company has recently built only motorships, and it is thought very probable that it will dispose ultimately of all its steamers and rely solely on motor vessels.

Liner to be Launched, Bremen, Germany.—The Norddeutscher Lloyd recently launched their new 9,000 ton liner Koeln from the Vulcan yard at Bremen. The vessel has a speed of 13 knots and has accommodations for 340 second class and 1,000 third class passengers.

Order Placed for Vessel, Stettin, Germany.—An order has been placed by the Norddeutscher Lloyd for the construction of a sister ship to the Minden, a cargo vessel for the same company, recently launched and having accommodations for a limited number of passengers, the vessel to be built in the Stettin yards. This new vessel will be fitted with turbine engines, however, and a third vessel is to have a Diesel motor arrangement. All three vessels will be combination passenger and cargo carriers.

STEAMSHIP INTERESTS—*(Continued)*

A fleet of eight passenger and freight ships which will be known as the Mexican Navigation Company will soon be placed in operation under the Mexican merchant marine, and nearly half of this tonnage will operate to San Francisco and other Pacific Coast ports. Agencies will be established at all principal ports. Vessels will call at Los Angeles and San Francisco on the Pacific Coast, and later on the company will extend the service to Seattle. Galveston, New Orleans and other Gulf ports will be included in the Atlantic service to New York. A regular service will be maintained to all ports of call, and the principal ports of South and Central America will be included in the service. Part of the company's program calls for the purchase of two combination passenger and freight steamers of 10,000 tons, these two vessels to be the largest of the fleet, and to be placed on the Pacific Coast run. Luis Martinez, one of the foremost shipping men in Mexico is said to be heading this organization. More than $4,000,000 has been raised throughout Mexico to aid in the Government's merchant marine, and it is reported that the development of this new line will be aided by the Mexican Government on a subsidy basis.

It is reported that Horace T. Bennett, Manatee, Fla., and W. E. Mann., Palmetto, Fla., with others are interested in establishing a company to operate a boat line at Bradentown, Pa.

In a contract recently awarded by the United States Post Office Department, the Admiral Line, Seattle, Wash., has put into effect a system analogous to the railway postal service in handling mail to and from the ports of Southwestern Alaska. United States Post Office clerks with duties corresponding to those of the men in charge of mail cars on the railroads will be placed aboard all passenger ships carrying Alaskan mails. The new contract, counterpart of one awarded simultaneously to the Alaska Steamship Company, authorizes a minimum compensation of $2,000 a round trip to southwestern Alaska, with a corresponding minimum for the service afforded the nearer ports of southeast Alaska.

BUSINESS NOTES

Mr. H. W. Parsons of the marine engineering department of the General Electric Company, 120 Broadway, New York, and for ten years in the service of that company has resigned to take up new duties with John R. Proctor, Inc., Bayonne, N. J., contracting engineers, in charge of their New York office at 120 Liberty Street. Mr. Parsons has an exceptionally wide acquaintance in the marine field and his many friends wish him success in his new enterprise.

The Marine Equipment & Supply Company, 116 Walnut Street, Philadelphia, Pa., announces that George S. Ruhland has resigned as president of the company, and William Kirkland, former secretary and treasurer, has been elected as president and treasurer. Percy L. Smith, who for many years has been engaged in the motorboat and shipbuilding industry, will be associated with the company in the capacity of secretary.

The firm of Mooney & Young has been changed to the General Engineering Company, with offices at 1013 Battery Street, San Francisco, Cal. George A. Armes, formerly president of the Moore Shipbuilding Company, is president; John F. Mooney is vice-president, and James H. Young is treasurer and secretary. The company conducts a machine and ship repair works.

The Exeter Machine Works, Inc., of West Pittston, Pa., announce the appointment of The Hendrie and Bolthoff Manufacturing and Supply Company, of Denver, Colo., as exclusive sales agents for the Exeter Rotary Pump line in the Denver district. The Hendrie and Bolthoff Manufacturing and Supply Company specialize in the marketing of tools, pumps and supplies for railways, machine shops and mills.

TRADE PUBLICATIONS

Tube Facts.—The manufacture of condenser tubes at the works of the Scovill Manufacturing Company, Waterbury, Conn., is taken up in detail in a booklet recently issued by this company. Season cracking and corrosion are the two principle causes of the failure of condenser tubes. In the Scovill laboratories investigations are being carried on continually to determine and eliminate causes of weakness in the structure of the metal. Modern manufacturing processes to a great extent eliminate many of the defects. Production of seamless tubing by both the drawing and cupping processes are outlined, as well as the production of Scovill Admiralty tubes. Special alloys, as bronze, nickel silver, naval brass, and the like, are made into Scovill tubing, as well as the condenser work.

Don't Let It Happen to You.—This book gives the story of a business venture that might have been profitable only inadequate equipment caused a loss on certain contracts rather than gains that had been expected. The Williams Tool Corporation, Erie, Pa., uses this story to introduce the proper principles, machinery and dies which should be used for pipe threading, and the necessity of always maintaining an adequate supply of spare dies and machine parts. The book is a complete treatise on pipe threading practice and will be supplied by the company free on request.

Drill Chucks.—Three circulars describing ball bearing, geared, and two jaw drill chucks have been sent out by the E. Horton & Son Company, Windsor Locks, Conn. Price lists are given, as well as the specifications.

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WE GUARANTEE that of this issue 6200 copies were printed; that of these 6200 copies 5057 were mailed to regular paid subscribers, 326 were provided for counter and news company sales, 259 were mailed to advertisers, 85 were mailed to employes and correspondents, and 473 were provided for new subscriptions, samples, copies lost in the mail, and office use; that the total copies printed this year to date were 51900—an average of 7414 copies a month.

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γεννάω—I Produce!

ONE hundred and forty-four years ago Lavoisier coined the name *Oxygen.*

In choosing the Greek word Γεννάω "I produce," as his main root he had in mind a chemical reaction commonly associated with the gas.

Had Lavoisier been able to foresee the tremendous part that Linde Oxygen is playing in modern industrial development, he would have realized the vast significance of that word Γεννάω "I produce!"

The country over, Linde Oxygen is daily making possible greater production—everywhere it is saving time and cutting costs.

A chain of seventy-five Linde plants and warehouses assures American welders and cutters of a prompt supply of highly pure oxygen—wherever they are, whatever their requirements.

THE LINDE AIR PRODUCTS COMPANY

Carbide and Carbon Building, 30 East 42nd Street, N. Y.

Kohl Building, San Francisco

The Largest Producer of Oxygen in the World

L-502-21

Ship and Sail Under the American Flag

ONE of the greatest events that has so far taken place in the development of our merchant marine will occur when the *George Washington* sails from New York on July 30 for Plymouth, Cherbourg and Bremen on her maiden voyage as a transatlantic liner under the American flag. This giant liner which is dear to the hearts of thousands of American soldiers whom she transported to and from the fields of battle "over there" and which has the distinction of carrying former President Wilson on his two historic crossings to France will provide every luxury known to ocean travel.

No longer can Americans excuse themselves for travelling on foreign vessels on the ground that there are no *Aquitanias* or *Olympics* in our service, for the flagship of the United States Mail Steamship Company is a twin-screw vessel of 25,570 gross tons providing the final word in steamship accommodations.

With vessels of this type in the service and still more to follow there can be no doubt that the American merchant marine is here to stay. The Shipping Board, however, cannot do it all, but it will furnish the vessels and then it is up to the American people to "ship and sail" under the Yankee flag.

Craftsmanship—What It Means

One of the oldest and noblest of human ideals is the ideal of the Craftsman—the code which bids the workman take pride in the skill of his hands, and employ that skill in none but worthy and useful ends.

Good intentions in shipbuilding would have little value unless expressed through skill in performance of each and all the complex tasks involved in the construction of a modern ship.

In the 19,000 men on our payroll, we have for twenty years and more been building up, primarily, an organization of CRAFTSMEN.

NEW YORK SHIPBUILDING CORPORATION
Camden, N.J.

Every Part Undergoes Rigid Inspection

A corner in the Inspection Room.

INTERCHANGEABILITY of parts means much to the turbine user and the mere fact that his repairs and replacements can be made in short order. It means that your Terry will be identical with the Terrys which have given long, continuous service without shutdown for repairs.

Our large volume of business is what makes interchangeability possible. It permits the use of special tools, special jigs and fixtures, and an energetic and alert Inspection Department, which insures a quality production at low manufacturing costs.

Though the price of a Terry may be high you can be assured that our saving is your saving and that interchangeability gives you not only 100 per cent. quality, but 100 per cent. value from your investment.

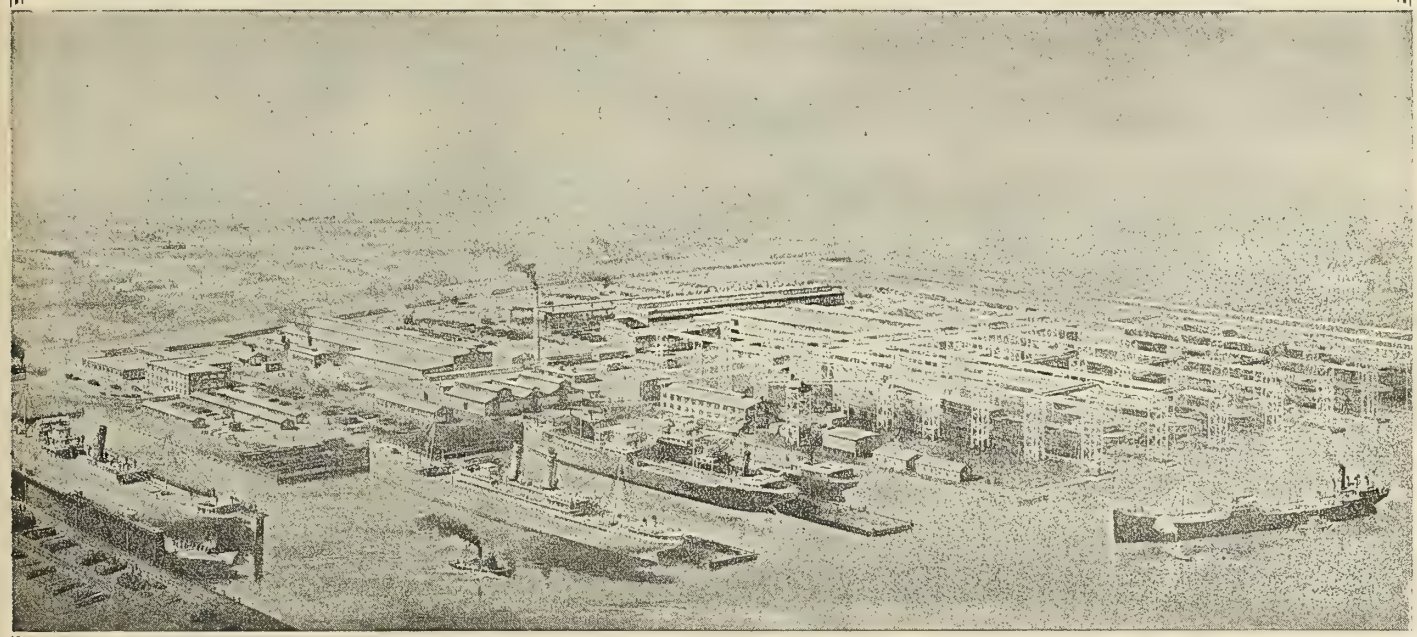
The Terry Steam Turbine Co.

Terry Square, Hartford, Conn., U. S. A.

T-711

THE TERRY TURBINE

Our New Ten Thousand Ton Floating Dry Dock Now Ready for Business!



CAPACITY OF SHIPYARD—EIGHT BUILDING WAYS, THREE LARGE WET DOCKS.
ENGINE BUILDERS—BOILER MAKERS—IRON FOUNDERS.
EXTENSIVE FACILITIES FOR SHIP, ENGINE AND BOILER REPAIRS.

BUILDERS OF HIGH CLASS SINGLE AND TWIN SCREW PASSENGER AND CARGO VESSELS, ALSO BULK OIL TANKERS, UP TO 600 FEET IN LENGTH

SUN SHIPBUILDING COMPANY

Main Office and Shipyard **Chester, Penna, U. S. A.**

Largest Repair Plant i

AEROPLANE VIEW OF PLANT

JAMES SHEWAN

Over 50 Years of Co

Brooklyn Yard

Ft. of 25th, 26th, 27th and 28th Streets

Port of Greater New York

Dry Docks: There are 10 dry docks ranging from 500 to 12,000 tons. No. 7 is 450 ft. Long, 110 ft. Breadth, 35 ft. Draft over Keel Block and 12,000 ton capacity.

Floating Derricks: The Derrick boats are of 10, 15, 20, and 40 tons capacity.

Tugs and Launches: For moving and shifting vessels, there are four ocean-going tugs, and four steam launches to take workmen to vessels anchored in the stream.

Electric Welding Barges and Floating Air Compressors: Four twin unit electric welding barges. Two air compressor barges.

Special Equipped Barge: Barge equipped to furnish steam and apply water pressure to boilers.

Boiler Shop: 475 ft. x 75 ft. Equipped with electric hoists, compressors—oil burning plate heating furnace 35 ft. x 8 ft.—oil burning bar heating furnace 55 ft. x 5 ft.

Machine Shop: 296 ft. x 70 ft.—equipped with two electric cranes—capacity up to 50 tons.

Power Plant: 73 ft. x 70 ft.

Electric and Air Compressor Plant: 60 ft. x 70 ft.

Pipe Fitting Shop: 75 ft. x 150 ft.

Coppersmith, Tinsmith and Plumbing Shop: 250 ft. x 80 ft.

Blacksmith Shop: Contains thirty blacksmith fires and six large steam hammers, with all necessary appliances.

Saw Mill, Joiner, Carpenter and Pattern-maker Shop: 140 ft. x 69 ft.

Berthing Facilities: Forty Steamers with a mean draft of about 35 ft. can be easily berthed.

Fire Equipment: Automatically operated pressure pump maintains a constant pressure of 125 lbs. throughout the entire yard. The fire boat "Seth Low," formerly operated by the New York Fire Department, has been overhauled, is in first class fire fighting condition and is available at all times.

Railroad Siding: Railroad siding connecting with Bush Stores and the D. L. & W. R. R.

All the dry docks are motor driven; air compressors and all other machinery are electrically equipped. In this immense store yard is a vast amount of repair material including 5,000 tons of plates and angles.

JAMES SHEWAN & SONS, Inc., is in a position to handle any size conversion or repair job.

x SONS, Inc.

nuous Operation

New York Office
32 Broadway

Largest Repair Plant in Port of Greater New York

AEROPLANE VIEW OF PLANT

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JAMES SHEWAN & SONS, Inc.

Over 50 Years of Continuous Operation

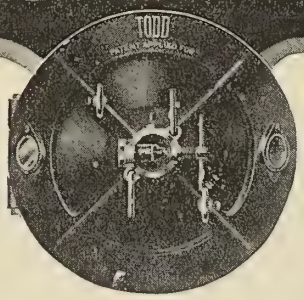
Brooklyn Yard
Ft. of 25th, 26th, 27th and 28th Streets

New York Office
32 Broadway

TODD-SYSTEMS-WHITE

MECHANICAL OIL BURNING

EFFICIENCY
SIMPLICITY



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TODD MECHANICAL OIL BURNER is the finished product of years of untiring experimentation and development in burning fuel oil mechanically.

700 INSTALLATIONS

On Vessels of the Leading Steamship Companies U. S. Shipping Board and U. S. Navy Including Many of the Largest and Most Powerful Steamships in the World

LET OUR EXPERTS ADVISE YOU. ESTIMATES FURNISHED

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SEATTLE AND NORTHWEST:	TODD DRY DOCKS, Inc.	HARBOR ISLAND, SEATTLE, WASH.
CANADA:	N. E. McCLELLAND & CO., Ltd.	MONTREAL

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WHITE FUEL OIL ENGINEERING CORP.
ENGINEERS 742 East 12th St., New York PARSONS TURBINES
TELEPHONE — DRY DOCK 2300

WORLD'S LARGEST SHIP-REPAIR ORGANIZATION

Plant of Robins Dry Dock & Repair Company, Erie Basin, Brooklyn, N. Y.

SHIP BUILDERS
AND REPAIRERS
BOILERMAKERS
PARSONS TURBINES
OIL BURNING
INSTALLATIONS
ELECTRIC DRIVE
EQUIPMENT

NINETEEN
FLOATING DOCKS
TWO GRAVING DOCKS
TWELVE SHIPWAYS

PLANTS

Robins Dry Dock & Repair Company
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Tebo Yacht Basin Company
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Clinton Dry Docks, Inc.
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Todd Dry Dock & Construction Corp.
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CABLE "ROBIN" NEW YORK ALL CODES MAIN OFFICE 25 BROADWAY NEW YORK TELEPHONE BOWLING GREEN 6900

HELIOS

ANNOUNCEMENT

THE personnel added to our Engineering Staff is one of the noteworthy instances of development in our organization during the past few years.

From time to time men of large calibre, with ability in varied lines, have associated themselves with the Heine organizaation. While individual announcements have already been made, we believe the cumulative advantage to customers will be more readily appreciated by here listing a few of these men and some of their achievements:

JOHN HUNTER. Formerly Chief Engineer of the Union Electric Light & Power Company, St. Louis. The results obtained at the Ashley Street Station of this Company are a tribute to his pioneering ability in power plant improvement. By re-allocation of units, increased efficiencies and judicious additions to equipment the capacity here was increased from 12,000 kw. to 116,000 kw. *without* increase in the building. During the war Mr. Hunter was in charge of the yard of the Standard Shipbuilding Corporation at Shooters Island, N. Y. where 8300 men were employed at the time of the armistice. Mr. Hunter is a member of the Uniform Boiler Law Society, and of the Prime Movers Committee of the National Electric Light Association. He also served as Manager and later as Vice-President of the American Society of Mechanical Engineers.

CHARLES H. STODDARD. Formerly Chief Engineer of Moore Ship-building Company, San Francisco, and previously Civilian Superintendent of shops at Mare Island Navy Yard. Few men have had as much experience in designing a great variety of machinery as Mr. Stoddard—boilers and engines of all types and sizes, mining hoists and mining machinery,—likewise steam vessels ranging from tug boats to

HEINE LARGE UNIT BOILERS

warships. It is also interesting to note that Mr. Stoddard actively co-operated in the design of three of the largest air compressors ever built in the United States.

ALFRED COTTON. Some of the early refinements on mechanical stokers were made by Mr. Cotton, while in the employ of Thomas Henderson, Liverpool, England, a pioneer in mechanical stokers and grates. He also designed one of the very first—if not the first—multi-stage centrifugal pumps. Later Mr. Cotton held a responsible position on the Engineering Staff of Lever Brothers, Ltd., one of the largest soap works in the world. As Chief Ass't Engineer for Meldrum Brothers, Ltd., Manchester, England, he collaborated in the development of the Meldrum Municipal Refuse Destructor. Amongst Mr. Cotton's personal inventions is the Cotton Forced Draft Furnace.

J. R. FORTUNE. Mr. Fortune was the Chief Engineer of the Automatic Furnace Syndicate of London. When that company was taken over by the Underfeed Stoker Company of Great Britain, he was retained as Chief Engineer and Works Manager. Later Mr. Fortune served as European Sales Manager of the Murphy Iron Works Company of Detroit, manufacturers of Murphy Stokers and Furnaces, and was finally called to Detroit to be Chief Engineer and Works Manager. While in Detroit he also acted as a Director of the Steere Engineering Company, Consulting Gas Engineers. From 1915 to 1917 he was engineer-assistant to Mr. John Dodge, President of Dodge Brothers, automobile manufacturers. During the war Mr. Fortune served as Efficiency Engineer at the large gun and shell plant of the American Brake Shoe Company at Erie, Pa.

The experience and service of these men and of many others of our organization are offered to power plant engineers and executives to help with whatever installation and operating problems they may have. Correspondence is invited.

HEINE SAFETY BOILER COMPANY
ST. LOUIS, U. S. A.
New York Boston Chicago Cincinnati New Orleans
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Also Agencies in many other cities
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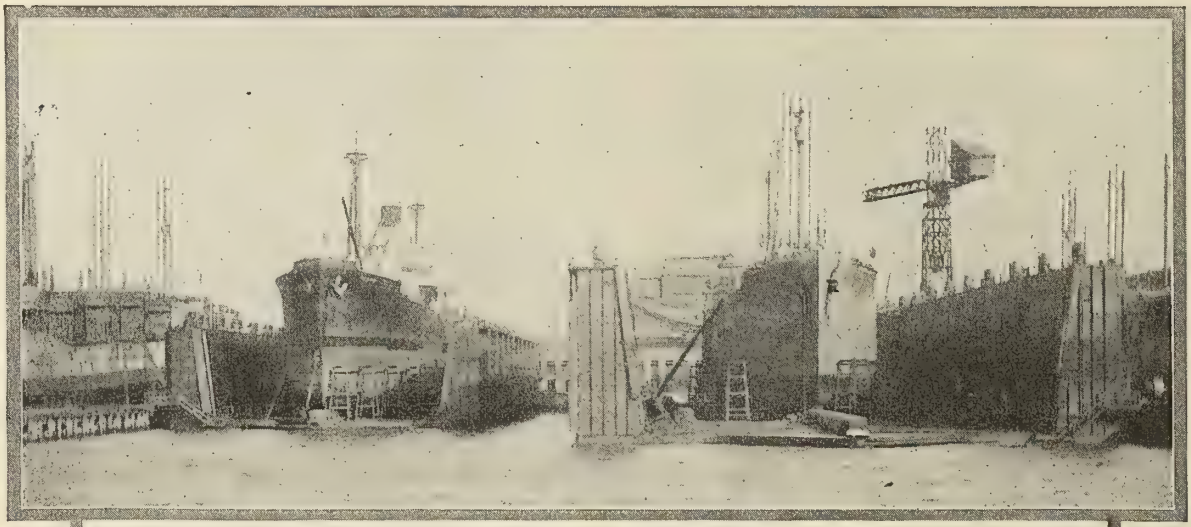
HEINE LARGE UNIT BOILERS

BETHLEHEM

SHIP BUILDING — SHIP REPAIRING



6,000 and 20,000-Ton Floating Dry Docks, Sparrow's Point Plant

Complete Facilities

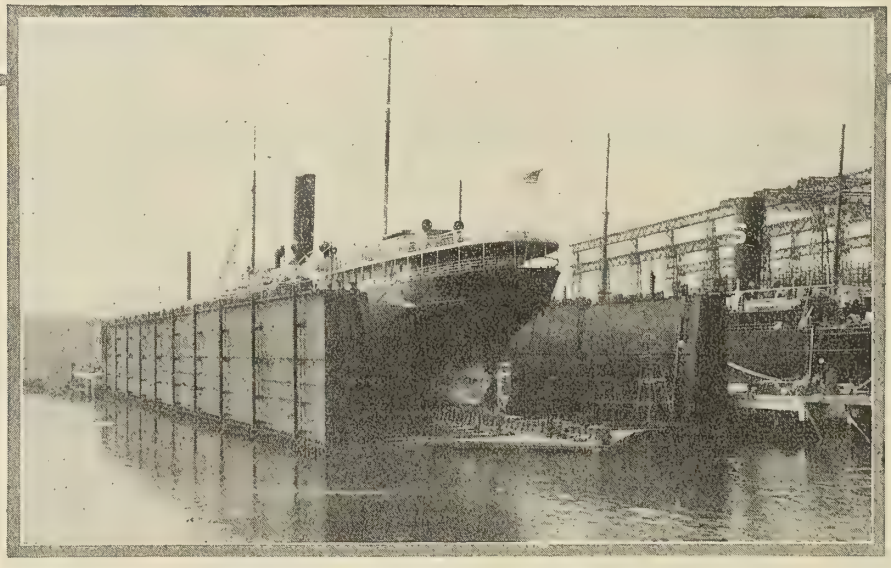
For Building All Types of Naval and Merchant Vessels and the Prompt Execution of Marine Repairs of Every Description

PLANTS

Fore River, Quincy, Mass.	Harlan, Wilmington, Del.	Union, San Francisco, Cal.
Moore, Elizabeth, N. J.	Sparrow's Point, Sparrow's Point, Md.	Redington, Redington, Pa.

DRY DOCKS

Floating Dock Quincy, Mass.	Graving Dock Wilmington, Del.	Two Floating Docks Sparrow's Point, Md.	Three Floating Docks Two Graving Docks San Francisco, Cal.	Two Marine Railways One Floating Dock Alameda, Cal.



10,000-Ton Floating Dry Dock, Fore River Plant

BETHLEHEM SHIPBUILDING CORPORATION, LTD.

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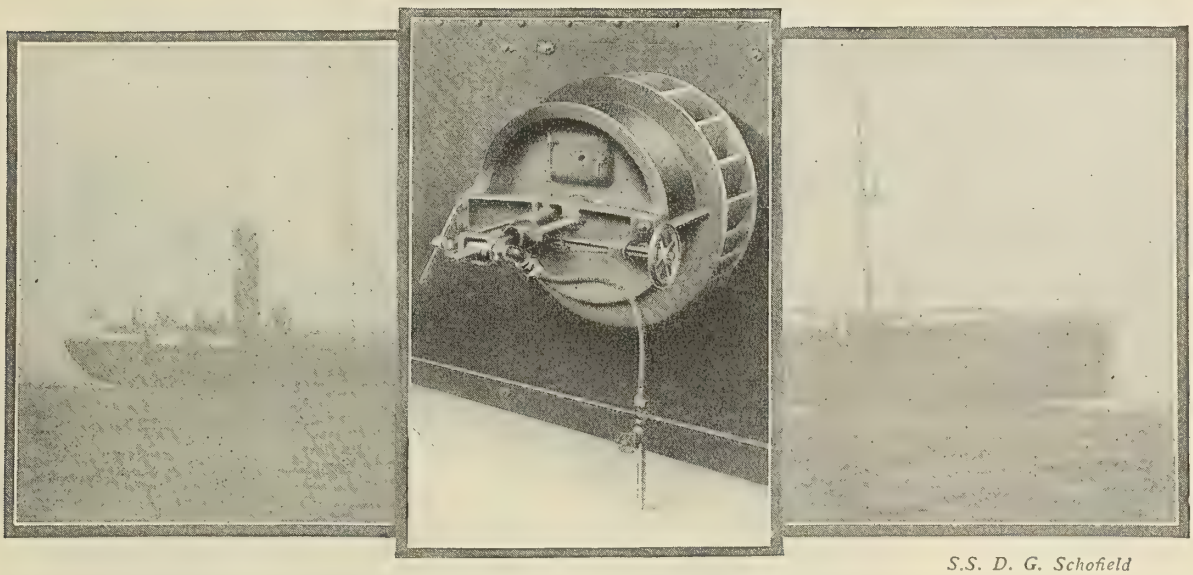
BETHLEHEM

MECHANICAL OIL BURNING EQUIPMENT



S.S. D. G. Schofield

Bethlehem (Dahl) Mechanical Oil Burning System

MORE POWER AT LESS COST

The following data is from the log of the S. S. D. G. Schofield, 11,950 ton Tanker, equipped with the Bethlehem (Dahl) Mechanical Oil Burning System:

No. of Trips.....93
Distance .....207,213 nautical miles
Period of Time Covered...3½ years
Average Fuel Oil Consumption per I. H. P. per hour .80 pounds, steaming

This is but one example of the remarkably low fuel oil consumption being obtained by Bethlehem (Dahl) installations.

Low fuel oil consumption, simplicity of operation, low first cost—these are some of the reasons why this system occupies the foremost place in marine installations.

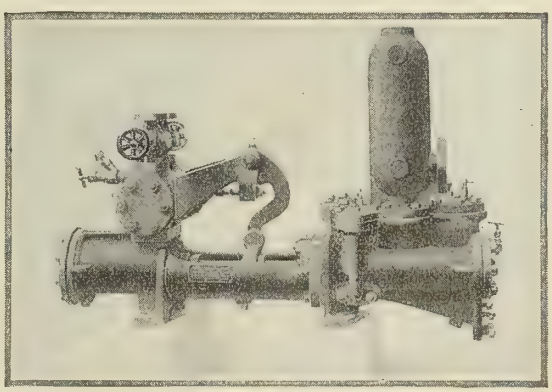
Write for Catalog O

BETHLEHEM-WEIR FUEL OIL SERVICE PUMPS

For Pumping Fuel Oil to Mechanical Oil Burners

These pumps are designed especially for delivering oil at pressures up to 200 pounds, and are guaranteed to deliver the oil at any predetermined *constant* pressure at the burner tips.

Catalogs of complete line of Bethlehem-Weir Machinery on Request



Fuel Oil Service Pump

BETHLEHEM SHIPBUILDING CORPORATION, LTD.

General Offices: BETHLEHEM, PA.

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Painters stake their lives on WHITLOCK ROPE

They know they are safe, for they know Whitlock All-Manila Rope is made of the same strong, high-grade, dependable fibre straight through. It is the rope that withstands the severest outdoor tests of wind, weather and hard work. You can not afford to take chances on the rope you use for your scaffold. Play safe—buy Whitlock.

WHITLOCK CORDAGE
THE UTMOST IN ROPE VALUE

Hardware dealers and ship chandlers throughout the country are building business with Whitlock Guaranteed Cordage Products. The man who buys Whitlock comes back for more.

Whitlock All-Manila is the rope that is guaranteed superior in every respect to the U. S. Bureau of Standards Specifications.

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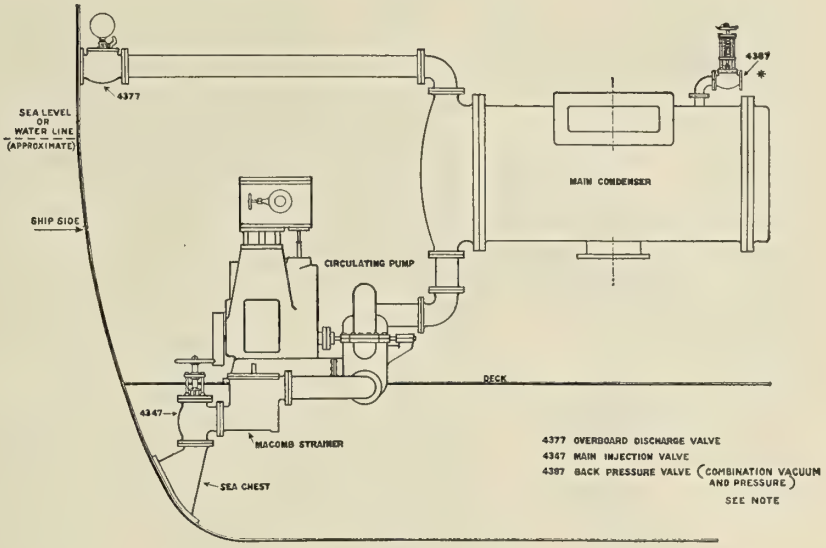
CRANE

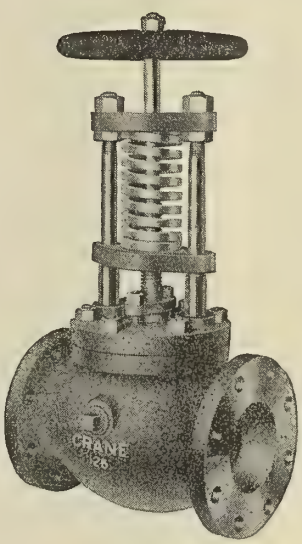
Marine Valves and Fittings



Section of a ship illustrating the method of taking water from the sea for condensing purposes.

successfully withstand all the exacting requirements of the leading inspection bureaus and may be relied upon for dependable and accurate operation under all the varying conditions of marine service.

We are manufacturers of about 20,000 articles, including valves, pipe fittings, and steam specialties, made of brass, iron, ferrosteel, cast steel and forged steel, in all sizes, for all pressures and all purposes, and are distributors of pipe, heating and plumbing materials.



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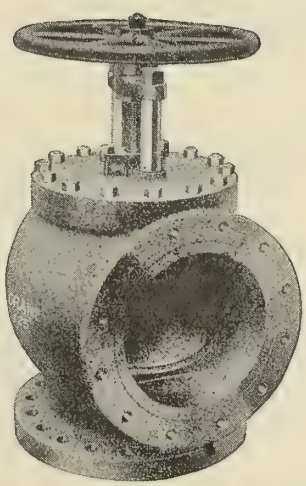

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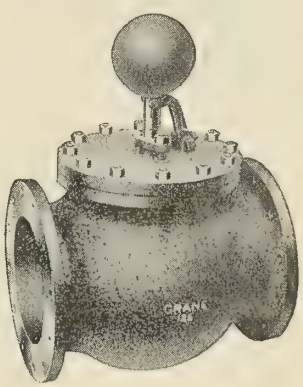

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SALES OFFICES, WAREHOUSES AND SHOWROOMS:

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CHICAGO

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CRANE LIMITED — MONTREAL, TORONTO, VANCOUVER, WINNIPEG, CALGARY, REGINA, HALIFAX, OTTAWA, LONDON, ENG.

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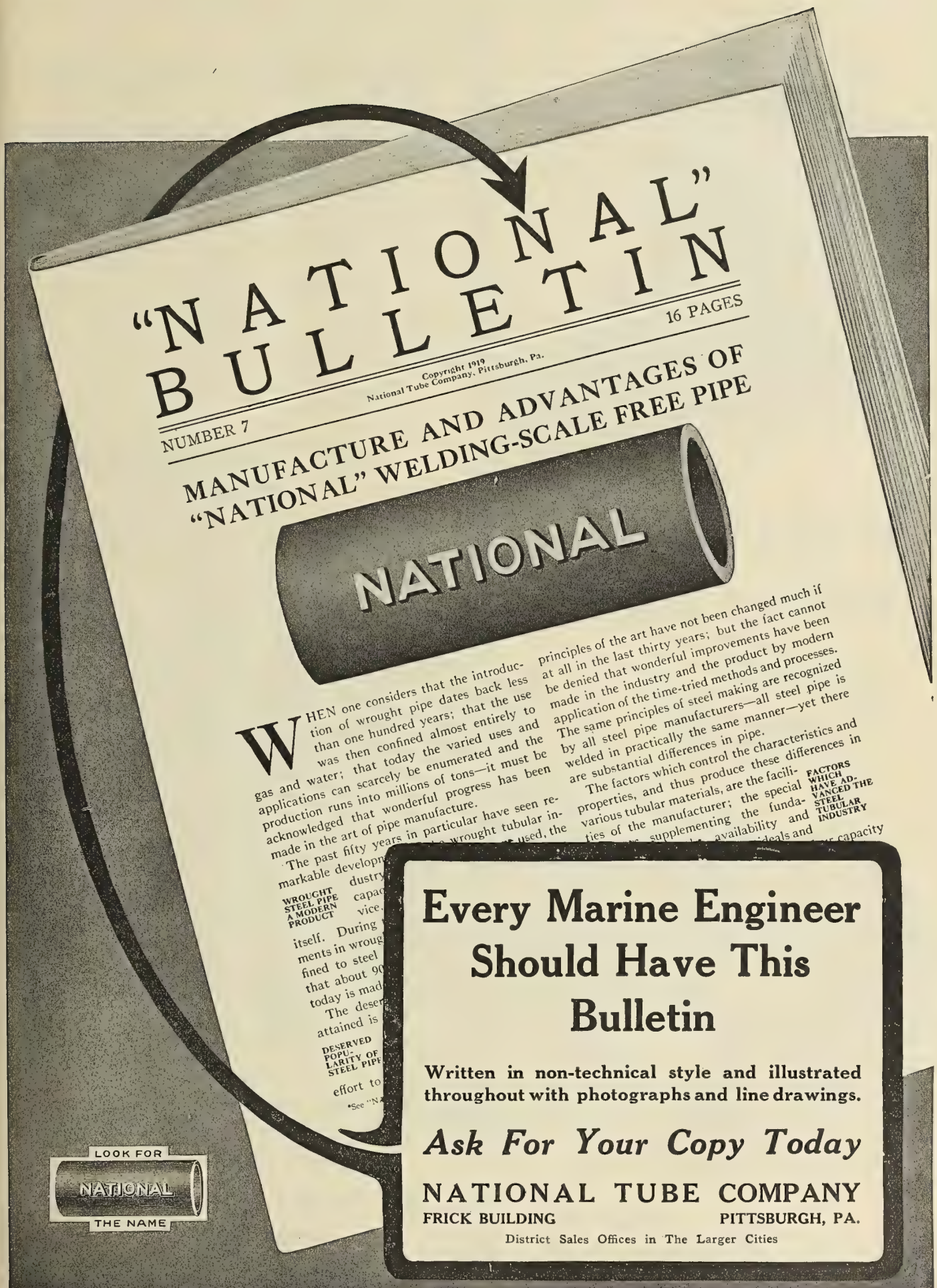
this rope with the red, white and blue Tape-Marker is the *only rope.* It's the Columbian Tape-Marked Pure Manila brand and its quality, strength and even service is guaranteed by the manufacturers.

Every piece of rope aboard must show the colored *Tape-Marker* to pass muster when a Captain takes pride in his ship."

COLUMBIAN ROPE COMPANY
342-90 Genesee Street
Auburn, N. Y.—"The Cordage City"
Branches:—New York - Boston - Chicago - Baltimore - Houston


"NATIONAL"
BULLETIN
NUMBER 7
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National Tube Company, Pittsburgh, Pa.
16 PAGES
MANUFACTURE AND ADVANTAGES OF
"NATIONAL" WELDING-SCALE FREE PIPE
NATIONAL
WHEN one considers that the introduction of wrought pipe dates back less than one hundred years; that the use was then confined almost entirely to gas and water; that today the varied uses and applications can scarcely be enumerated and the production runs into millions of tons—it must be acknowledged that wonderful progress has been made in the art of pipe manufacture.
The past fifty years in particular have seen remarkable
WROUGHT STEEL PIPE A MODERN PRODUCT
itself. During
fined to steel
today is mad
The dese
attained is
DESERVED POPULARITY OF STEEL PIPE
effort to
principles of the art have not been changed much if at all in the last thirty years; but the fact cannot be denied that wonderful improvements have been made in the industry and the product by modern application of the time-tried methods and processes. The same principles of steel making are recognized by all steel pipe manufacturers—all steel pipe is welded in practically the same manner—yet there are substantial differences in pipe.
The factors which control the characteristics and properties, and thus produce these differences in various tubular materials, are the facilities of the manufacturer; the special
FACTORS WHICH HAVE ADVANCED THE STEEL TUBULAR INDUSTRY
supplementing the fundamental availability and
LOOK FOR
NATIONAL
THE NAME

Every Marine Engineer Should Have This Bulletin

Written in non-technical style and illustrated throughout with photographs and line drawings.

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FRICK BUILDING PITTSBURGH, PA.

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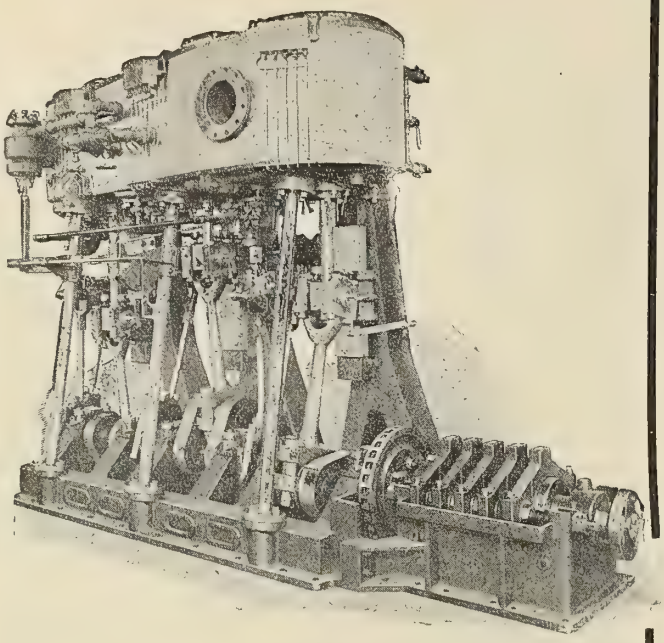


If It's Marine Mechanical Equipment Consult KEARFOTT

—Because that is the best way to assure yourself that the equipment selected will be best suited to your particular needs.

—because you gain the advantage that Kearfott's close manufacturing connections bring

—because Kearfott Service is at your disposal—

—because of prompt deliveries

—because Kearfott can supply all marine mechanical equipment from engines to anchor chains

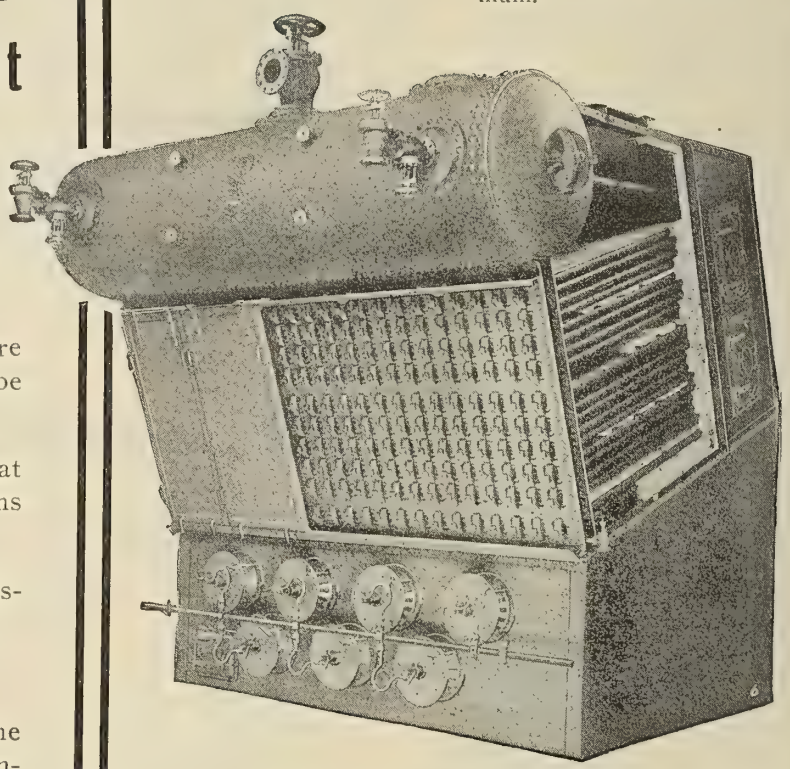
—and because Kearfott has served both ship owners and masters for many years and knows the needs of each.

Kearfott Engineering Co., Inc.
95 Liberty Street, New York

K-38

The Ward Leads the Watertube Boiler Field

In first cost	The Ward Watertube Boiler costs far less than others of its class.
In installation	Large units may be shipped ready to be lowered to their settings.
In weight	Horsepower for horsepower Ward Boilers are much lighter in weight and outrank Scotch boilers in capacity.
In economy	Evaporation tests show 17 pounds of water to one pound of oil.
In long life and upkeep	Seamless drawn tubes—absence of nipple connections — absence of stay-bolts—and all-steel construction, secure an unsurpassed durability and cut upkeep costs to a minimum.



Now is the time to buy Ward Boilers for the ship on the ways.

Write for descriptive literature.

The Charles Ward Eng. Works
Charleston, W. Va.

Eastern Agent
Kearfott Engineering Co., Inc., 95 Liberty St., N. Y.

WB-38

W. L. Brubaker & Bros. Co.

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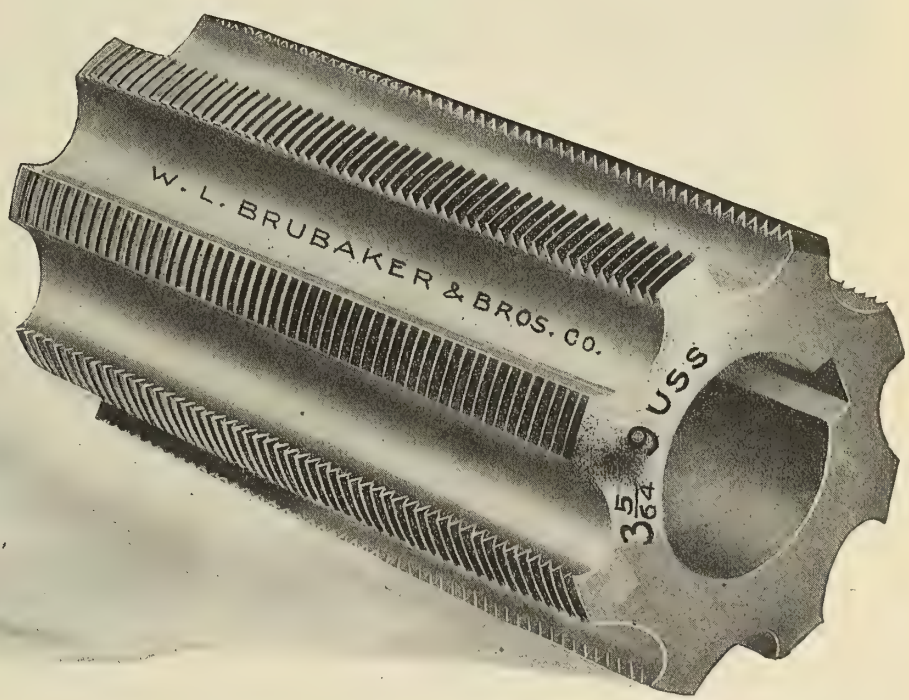
Mfrs.
Taps, Dies & Reamers
Common Sense Screw Plates

Factory at
Millersburg, Pa.

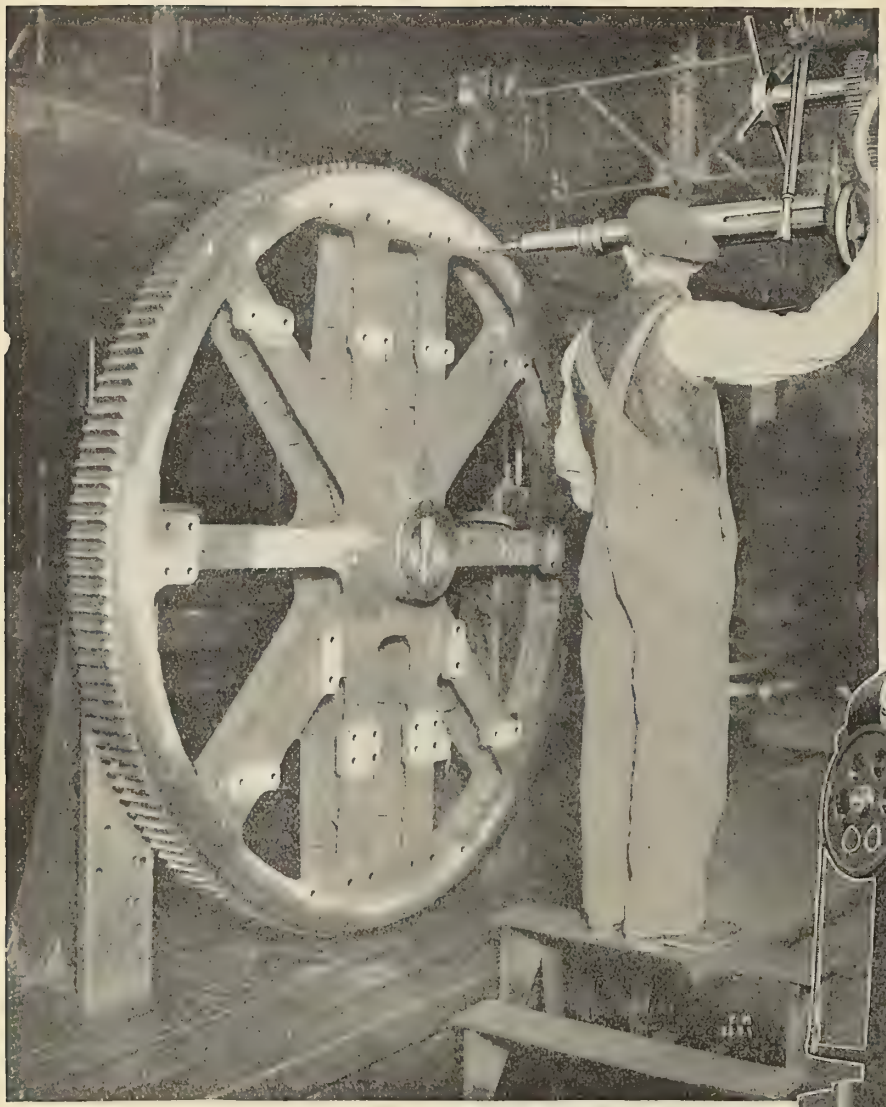
STAY-TUBE TAPS

ALL SIZES — ANY LENGTH
FURNISHED IN TEN DAYS



Special Temper—Well Relieved—Easy Cutting—Best Grade Tool Steel. Manufactured by Us Many Years—Carbon or High Speed Steel as Desired.

W. L. BRUBAKER & BROS. CO.



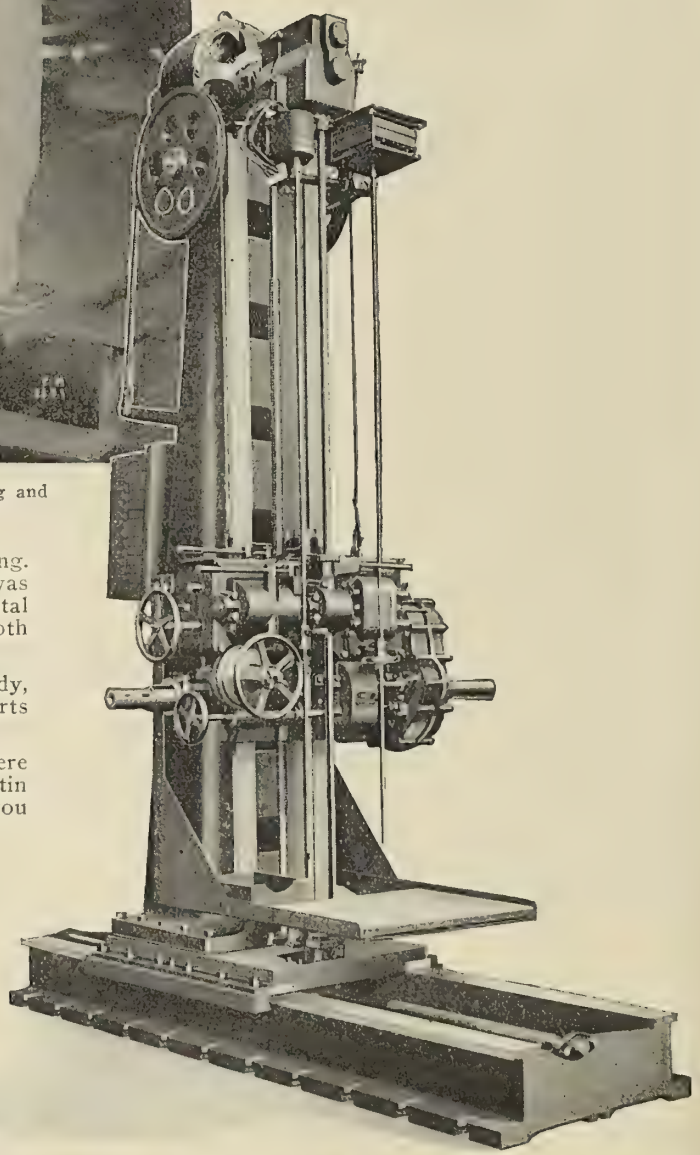
Keeping Costs Down by Simplifying Set-up and Handling

P & H Drilling and Boring Machines, cut down the time of drilling and back-facing. Operator can easily watch work on both sides

HERE is a job requiring drilling of 50 holes and backfacing. One man set it up. The drilling and backfacing was done quickly and with no further handling. The total drilling time was only a little more than a minute a hole. Both sides of the piece worked on were readily accessible.

P & H Drilling and Boring Machines are making speedy, accurate work of this kind possible in many plants in all parts of the country.

In looking for means of reducing costs in your shop, there is no better time than the present to get our descriptive Bulletin 214. A request sent to any of the addresses below will bring you a copy and any specific information you may desire.



Machine Tool Division
PAWLING & HARNISCHFEGER CO.
Milwaukee, Wis., U. S. A.

DALE MACHINERY CO., Inc.
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CHICAGO: 541 W. Washington Blvd.

St. Louis...Blackman-Hill-McKee Machinery Co., 1513 No. Broadway
Birmingham.....C. B. Davis Engineering Co., Brown Marx Bldg.
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P & H Branch Offices: Los Angeles, San Francisco, Seattle, Portland and New Orleans

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Whenever the Task involves Towing
"Wall" Manila Hawsers
Always Merit the great Trust imposed

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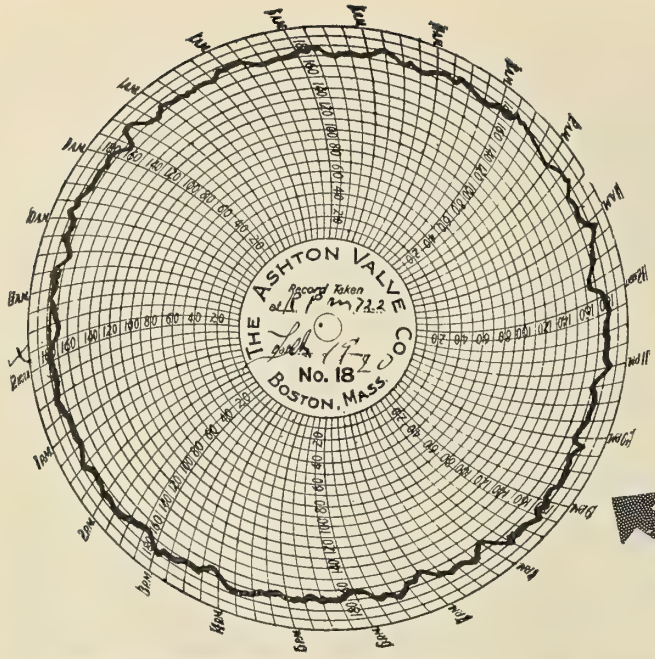


BEFORE
Installing Diamond Soot Blowers on S. S. Delfina
Stack Temperatures 600° to 615°
Average Revolutions about 72

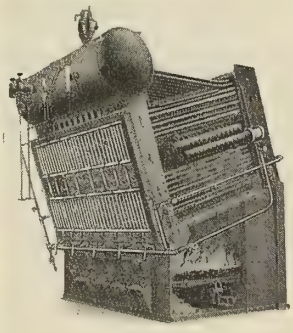
Which?

Do Your Boiler Logs Show High or Low Operating Costs?

It is just as easy, and a great deal more satisfactory and desirable to operate your vessel economically as regards the power end, rather than wastefully. Take the case of the S. S. "Delfina," a Shipping Board vessel now operated by the Munson Line and running between New York and Buenos Aires. This vessel was originally a poor steamer; the stack temperatures were very high and the stack had taken fire due to the increased accumulation of soot. In order to eliminate these troubles and to decrease the fuel consumption, and increase the boiler efficiency, Diamond Soot Blowers were installed.

An immediate difference was apparent. The chart above, taken before the installation of Diamond Soot Blowers, shows an average steam pressure of 180 pounds. The average revolutions of the engine were 72 and stack temperatures were 600 to 615 degrees. As soon as Diamonds were installed the average boiler pressure jumped to 200 pounds, where it was easily maintained, the stack temperatures decreased to 450 to 475 degrees, and the average revolutions increased to about 80 per minute. A very marked saving in fuel also resulted. As a result of these savings, all of which are directly traceable to Diamond Soot Blowers, the Delfina now operates on a much more economical basis than ever before.

Diamond Soot Blowers are the best paying investment you can place in your vessel. For further information write for Bulletin No. 134.



The Delfina has Foster Boilers equipped with Diamond Soot Blowers

The blowers are of the front end type with nozzles extending through the hollow staybolts. The blowers are made up in vertical sections, each under the control of an individual valve. This arrangement permits of blowing three or four vertical rows of tubes at one time, thus avoiding all interference with the draft. Over 300 Foster Marine watertube boilers have been equipped with Diamond Soot Blowers.

"It gives me great pleasure to state that Diamond Soot Blowers have made good every claim made for them.

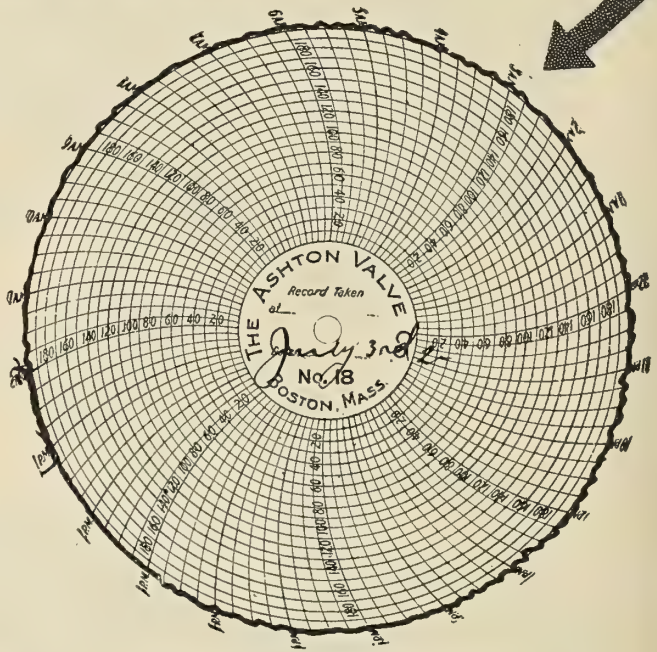
"The S. S. Delfina is equipped with three Foster Boilers and uses oil fuel.

"On voyage from Gulfport, Miss., to Buenos Aires the following averages were obtained:

Steam pressure 200 pounds,
Revolutions of main engines, 79.5 per minute.
Fuel consumption, 68.7 barrels per 100 miles.
Stock temperature, 440 degrees.

"I, therefore, recommend Diamond blowers for all types of boilers using coal or oil for fuel."

F. W. Failmore,
Chief Engineer.



AFTER
Installing Diamond Soot Blowers on S. S. Delfina
Stack Temperatures 450° to 475°
Average Revolutions about 80

DIAMOND POWER SPECIALTY COMPANY
Detroit, Michigan

Diamond

SOOT BLOWERS - SAVE 4 to 8% FUEL

ON THE ADMIRALTY LIST

ALEXANDER STEPHEN & SONS, Ltd.

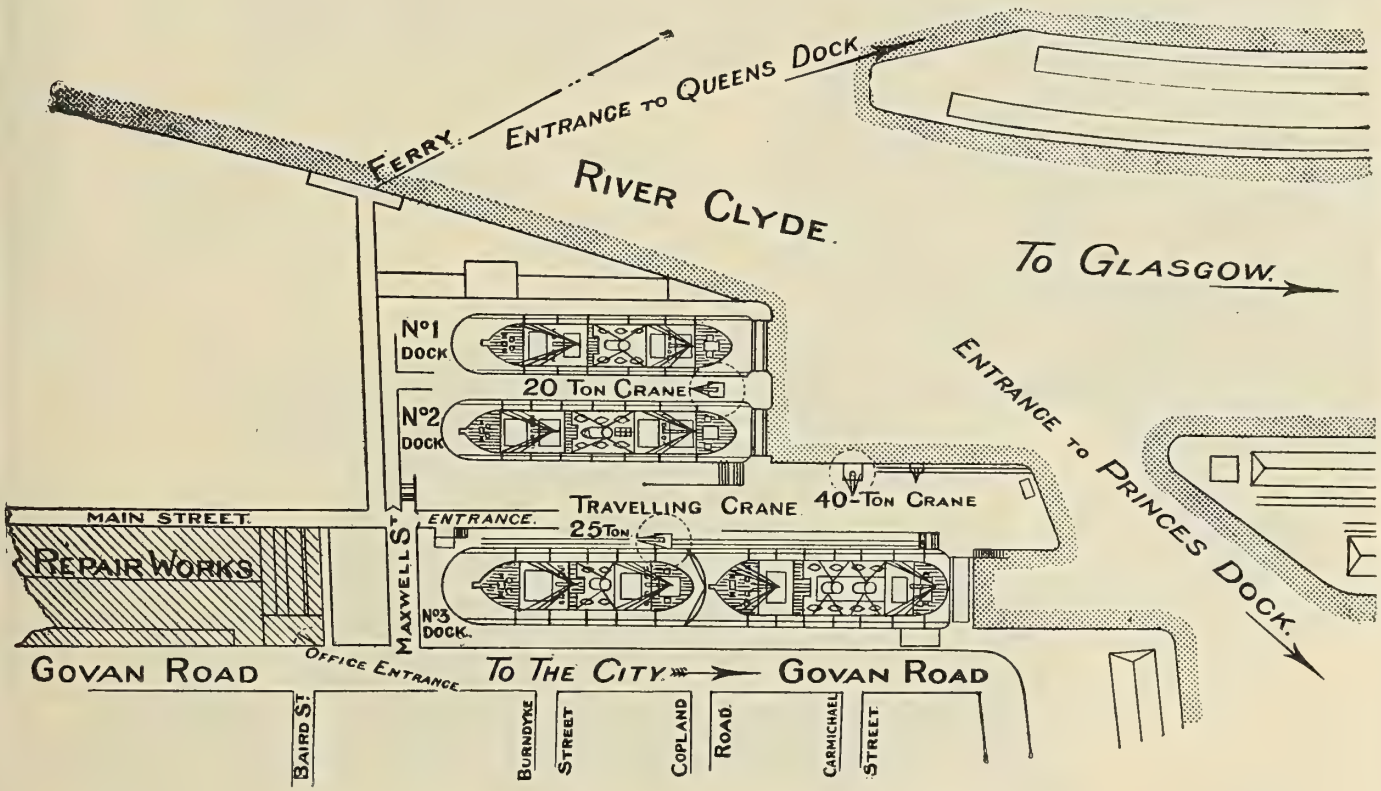
Shipbuilders——Engineers——Boilermakers

GOVAN GRAVING DOCK REPAIR WORKS

OFFICE: 604 GOVAN ROAD

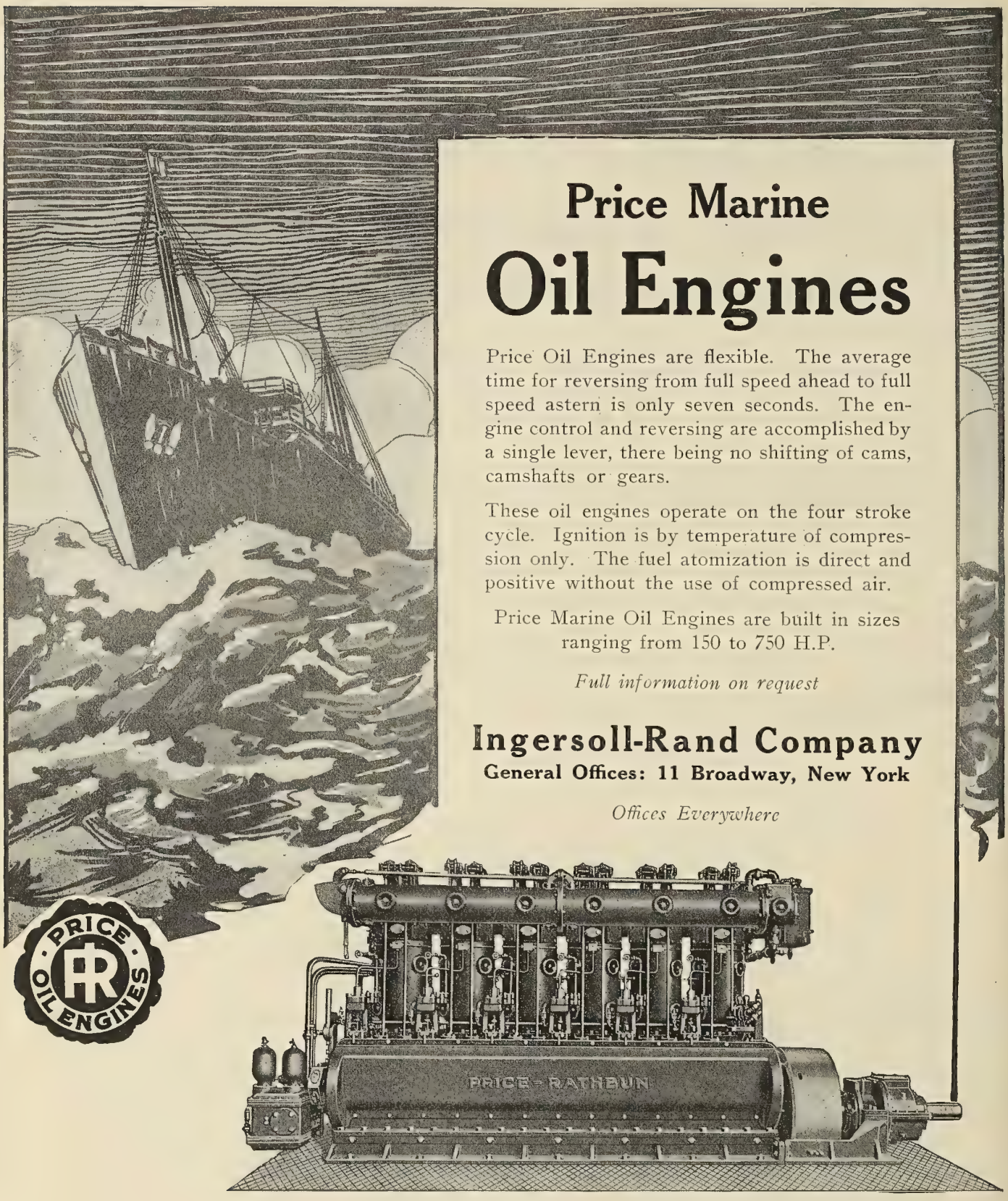
GLASGOW

VESSELS DOCKED AND PAINTED AND REPAIRS OF ALL KINDS EXECUTED TO HULLS, MACHINERY AND BOILERS WITH UP-TO-DATE APPLIANCES, INCLUDING OXY-ACETYLENE CUTTING AND ELECTRIC WELDING PLANTS.



OFFICES AND REPAIR WORKS ADJOIN THE LARGEST GRAVING DOCKS ON CLYDE AND ARE CONVENIENTLY SITUATED TO THE PRINCIPAL DISCHARGING, LOADING AND COALING BERTHS, THUS ENSURING CLOSE SUPERVISION AND ECONOMY OF TIME.

Telegrams: "MIDYARD, GLASGOW." Telephone: GOVAN 688 (4 lines).



Price Marine
Oil Engines

Price Oil Engines are flexible. The average time for reversing from full speed ahead to full speed astern is only seven seconds. The engine control and reversing are accomplished by a single lever, there being no shifting of cams, camshafts or gears.

These oil engines operate on the four stroke cycle. Ignition is by temperature of compression only. The fuel atomization is direct and positive without the use of compressed air.

Price Marine Oil Engines are built in sizes ranging from 150 to 750 H.P.

Full information on request

Ingersoll-Rand Company
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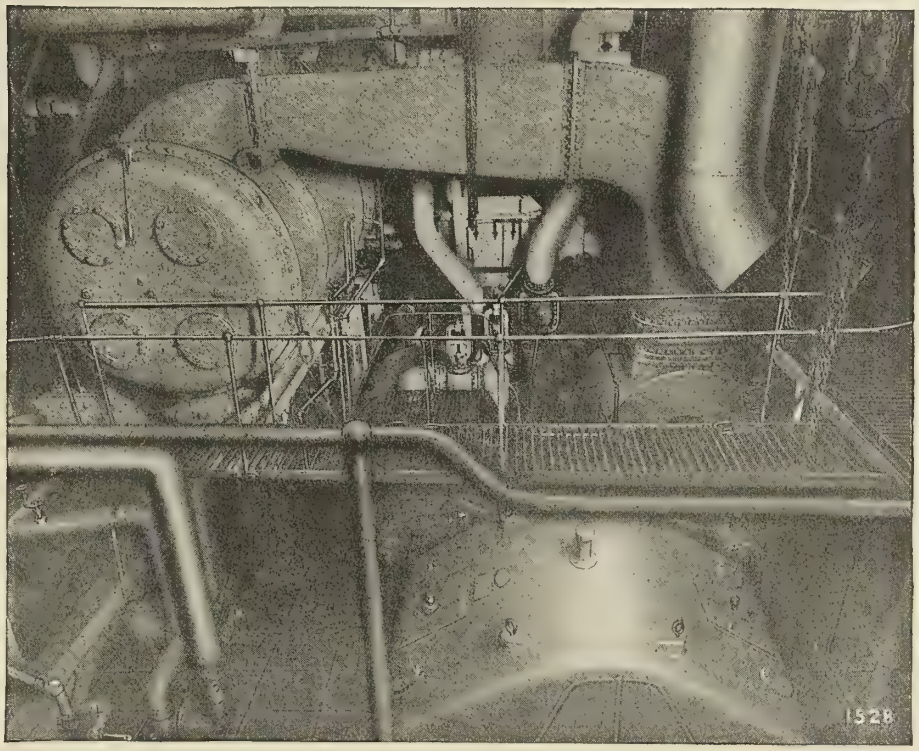
TURBINES *for* TANKERS



THE accompanying photograph shows a De Laval 3300-hp. compound double-geared marine turbine installed in the tanker W. M. BURTON. De Laval geared turbines are now being installed because of their reliability in five tankers of this type.

A visit to the engine room of such a ship will impress you with a very important fact, namely:

De Laval Gears Are Practically Noiseless

The absence of noise indicates correct design, proper cutting and finish and adequate support. It also foretells long wear and satisfactory service, and is a sure sign of high efficiency.

Noisy gears are objectionable for other reasons than that they soon wear out and give trouble. They deafen the crew, interfering with the most delicate and reliable means of detecting trouble, namely, the sense of hearing. Hearing is relied upon more than sight or touch in discovering and locating trouble in machinery. De Laval gears are practically noiseless.

Over 2,000,000 hp. of De Laval marine gears are in service and many of them have each made over 200,000 miles.

If you are interested in motive power for ships, give dimensions and conditions of service, and our Engineering Department will submit suggestions and drawings. Have you read our Marine Catalog M-46?

De Laval
Steam Turbine Co.
TRENTON, N. J.

174

LONG-BELL

TRADE-MARKED

Ship Timbers—Decking
Piling—Sheet Piling
Wood Blocks

These products from the mills of The Long-Bell Lumber Company, designed especially for marine purposes, are cut from exceptional stands of *Long Leaf* Southern Pine, the wood recognized by marine engineers everywhere as being unsurpassed for their unusual requirements.

Among the *added values* back of every shipment of Long-Bell products is exacting supervision of manufacture in thoroughly modern mills; unusual uniformity of grading; individual attention to orders; shipping supervision to prevent damage; large and diversified stocks; prompt shipments; and, very important, *the name of the manufacturer branded upon the product to show the buyer he is receiving without question these added values.*

Long-Bell Creosoted Piling is treated full length by pressure. The cells of the sapwood are filled with Creosote Oil, making the wood impervious to borers, bacteria, fungi and moisture.

The Long-Bell Lumber Company

R. A. LONG BUILDING Lumbermen since 1875 . KANSAS CITY, MO.

See that your Power Plant Apparatus is Monel equipped

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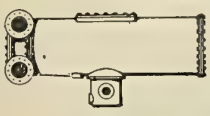

CONDENSERS
Westinghouse Electric & Manufacturing Co.

GOVERNORS
Waters Governor Co.
The C. E. Squires Co.
Northern Equipment Co.
S. C. Regulator Co.

INSTRUMENTS
The Bristol Company
Lewis M. Ellison
Schaeffer & Budenberg
Taylor Instrument Co.
Foxboro Co.
Brown Instrument Co.
Jos. W. Hays Corp.
American District Steam Co.

DIESEL ENGINES
De La Vergne Machine Co.
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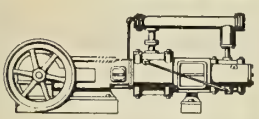

COMPRESSORS
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VALVES
The C. E. Squires Co.
The Fisher Governor Co., Inc.
Mason Regulator Co.
Consolidated Engine Stop Co.
G. M. Davis Regulator Co.
Foster Engineering Co.
Ford Regulator Co.
Schutte & Koerting
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Pratt & Cady
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Bethlehem Shipbuilding Corp., Ltd.
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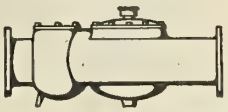

METERS
Bailey Meter Co.
Worthington Pump and Machinery Corp.
Pittsburgh Meter Co.
Equitable Meter Co.

SOOT BLOWERS
Everlasting Valve Co.
Vulcan Soot Cleaner Co.

PRESSURE REGULATORS
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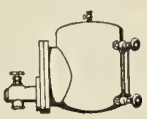
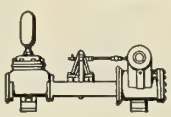
National Regulator Co.
Foster Engineering Co.
Boylston Steam Specialties Co.
Equitable Meter Co.
Ford Regulator Corp.
S. C. Regulator Mfg. Co.
Julian D'Este



TRAPS
Wright Austin Company
Sarco Company
The Fisher Governor Co., Inc.
The C. E. Squires Co.
Templeton Mfg. Co.
Elliott Co.



PUMPS
The Viking Pump Company
Blackmer Rotary Pump Co.
American Well Works
Worthington Pump and Machinery Corp.
Twinvolute Pump & Mfg. Co.
Chas. S. Lewis & Co.
Pennsylvania Pump & Compressor Co.
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Elliott Company

THIS is a partial list of manufacturers who insure the proper performance of their products by writing Monel metal into their specifications.

Monel is as strong as steel and has practically the same co-efficient of expansion. It is unaffected by alkalies and most acids and simply will not rust. There is no other metal possessing this balance of qualities. So more and more operators of power plants are substituting Monel parts in their old apparatus and insisting upon the use of Monel in all new equipment.

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The name Monel identifies the natural nickel alloy—67% nickel, 28% copper and 5% other metals—produced by The International Nickel Company. Monel products include Monel blocks, Monel rods, Monel castings, Monel sheet, Monel wire, Monel strip stock, etc.

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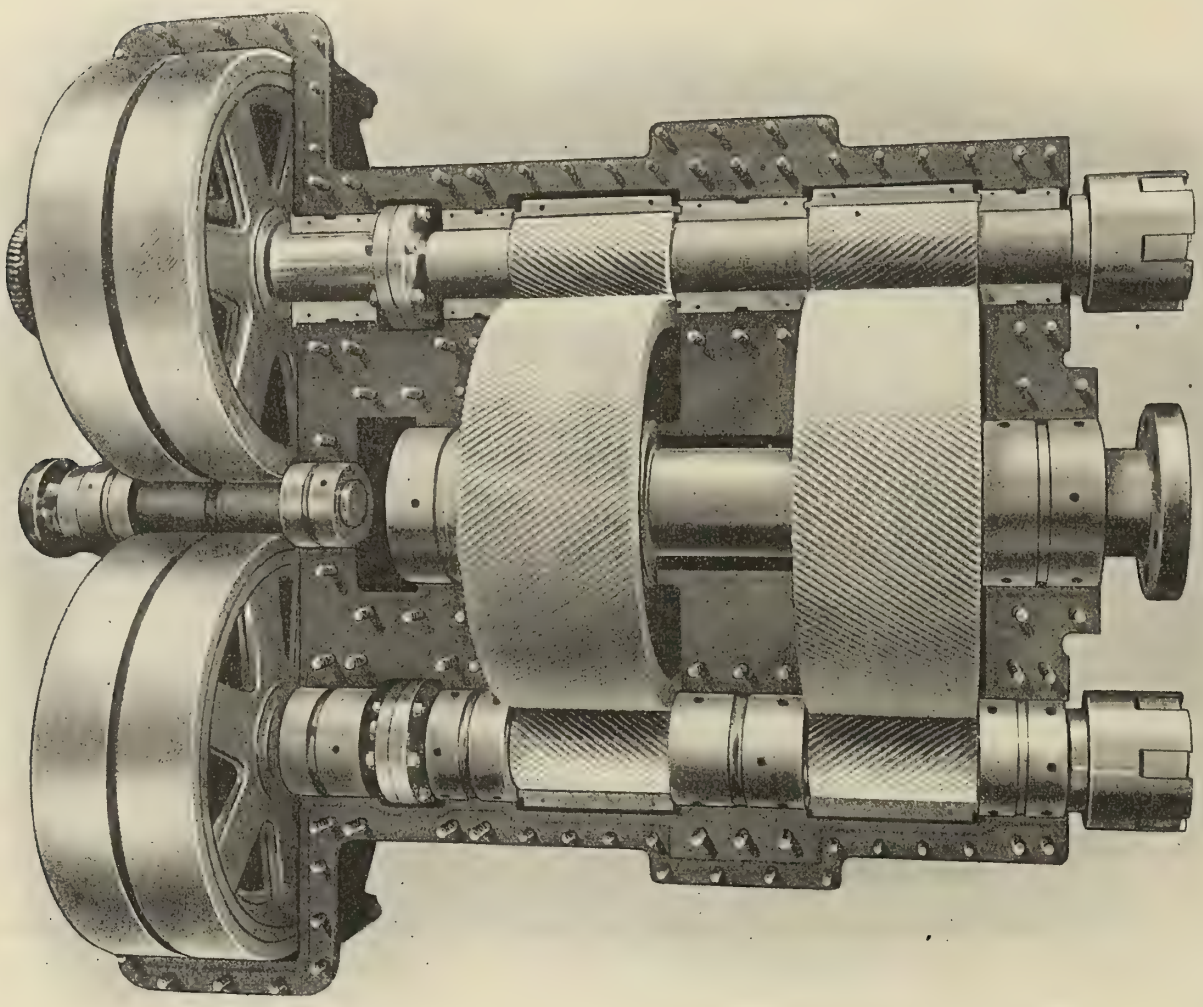

Plan View (cover removed) 2500 to 3000 S.H.P. Type

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Also Turbine Driven Auxiliaries, all sizes.

KERR TURBINE COMPANY

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KANSAS CITY, MO., 419 Reliance Bldg.
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PITTSBURGH, PA., Oliver Bldg.
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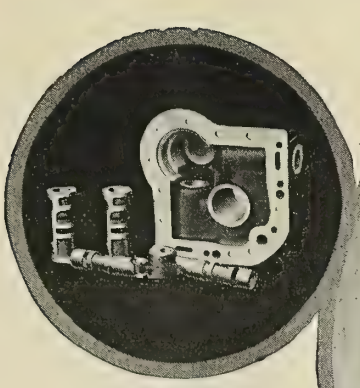
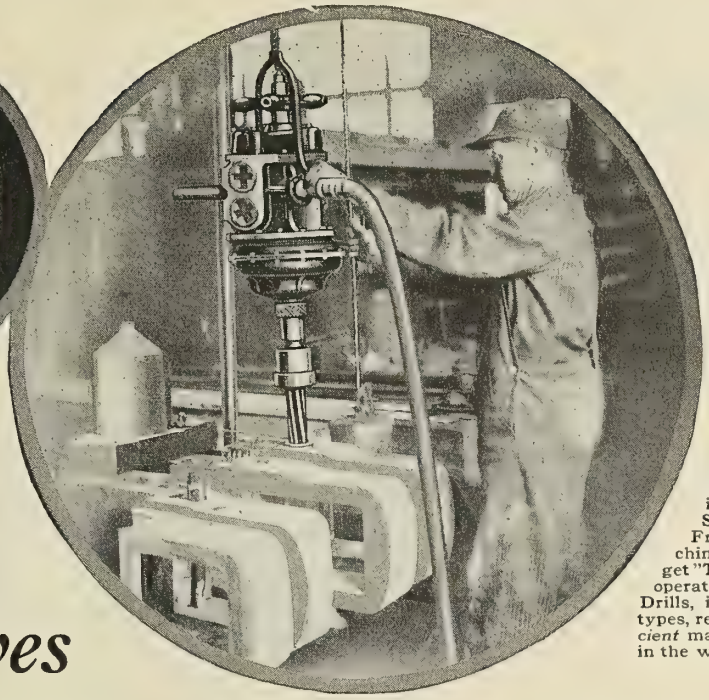
SAN FRANCISCO, CAL., Sharon Bldg.
ST. LOUIS, MO., Boatman's Bank Bldg.
MONTREAL, CANADA, Southam Bldg.
WINNIPEG, CANADA, 207 Scott Block.
LONDON, ENGLAND, 11 Carteret St.
HONOLULU, T. H.
SHANGHAI, CHINA.
TOKIO, JAPAN.
HAVANA, CUBA.



Balanced Piston Valves—
a *Little Giant* feature.



Little Giant Air Drill, No. 15R, reversible type. Drilling capacity, up to 3-inch holes in metal. Speed light, 80 R. P. M. From this powerful machine, down to the "Midget" Types for light drilling operations, Little Giant Air Drills, in their 67 sizes and types, represent the *most efficient* machines of their kind in the world!

Why the Valves in Little Giants resist wear indefinitely

WHEN two objects are rubbed together, friction is created and wear results. The harder they are pressed, the greater the wear. When air drill valves, held to their seats by pressure, are constantly rubbing together, wear is inevitable. With 100 pounds of air pressure entering a drill directly against valves, wear results. As the valve wears, it becomes smaller in diameter and its seat larger, causing leakage, and making valve replacements necessary.

Not so with Little Giant Air Drills. "*Long-wearing* and *leak-proof*" defines their balanced piston valves. They have no pressure holding them to their seats. Being balanced in all directions they require none; and moving but 1-20th of their length and devoid of rocker arms and gears, they require no appreciable power to operate, consequently remain tight indefinitely.

Furthermore, the eccentric being connected directly to the valve, eliminates unnecessary joints which cause lost motion and retard prompt opening and closing of the valves. The valve motion is so timed that the compression pressure, on the closing of the exhaust port at the finish of the stroke, almost equals that of the air supply line pressure. This timing would be impossible with any valve held to its seat by pressure, but with balanced piston valves, all waste air space, such as ports and cylinder clearance, is filled to air-line pressure before live air is admitted to the cylinders. Result—the *most efficient and economical air drill yet developed!*

Isn't this the kind of a drill you need in your plant to cut manufacturing and shop costs? Know all about Little Giant features. Address the nearest Branch for Engineering Service—rendered without obligation. Also ask for Bulletin 598.

Chicago Pneumatic Tool Company

Chicago Pneumatic Building - 6 East 44th Street - New York

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P-102

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
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LITTLE *The World's Standard* GIANT *Air Drill*

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Forging Steel Ship Liners

Wherever ships are being built Bradley Hammers are pounding away at their "bit."

They are built to stand the continuous strain of heavy work.

They are **accurate** and **rapid,** and attain big results in many kinds of forging.

With a **"Bradley"** you are sure of perfect control. Pressure on the foot treadle sets the hammer in motion. Release of the treadle stops the hammer.

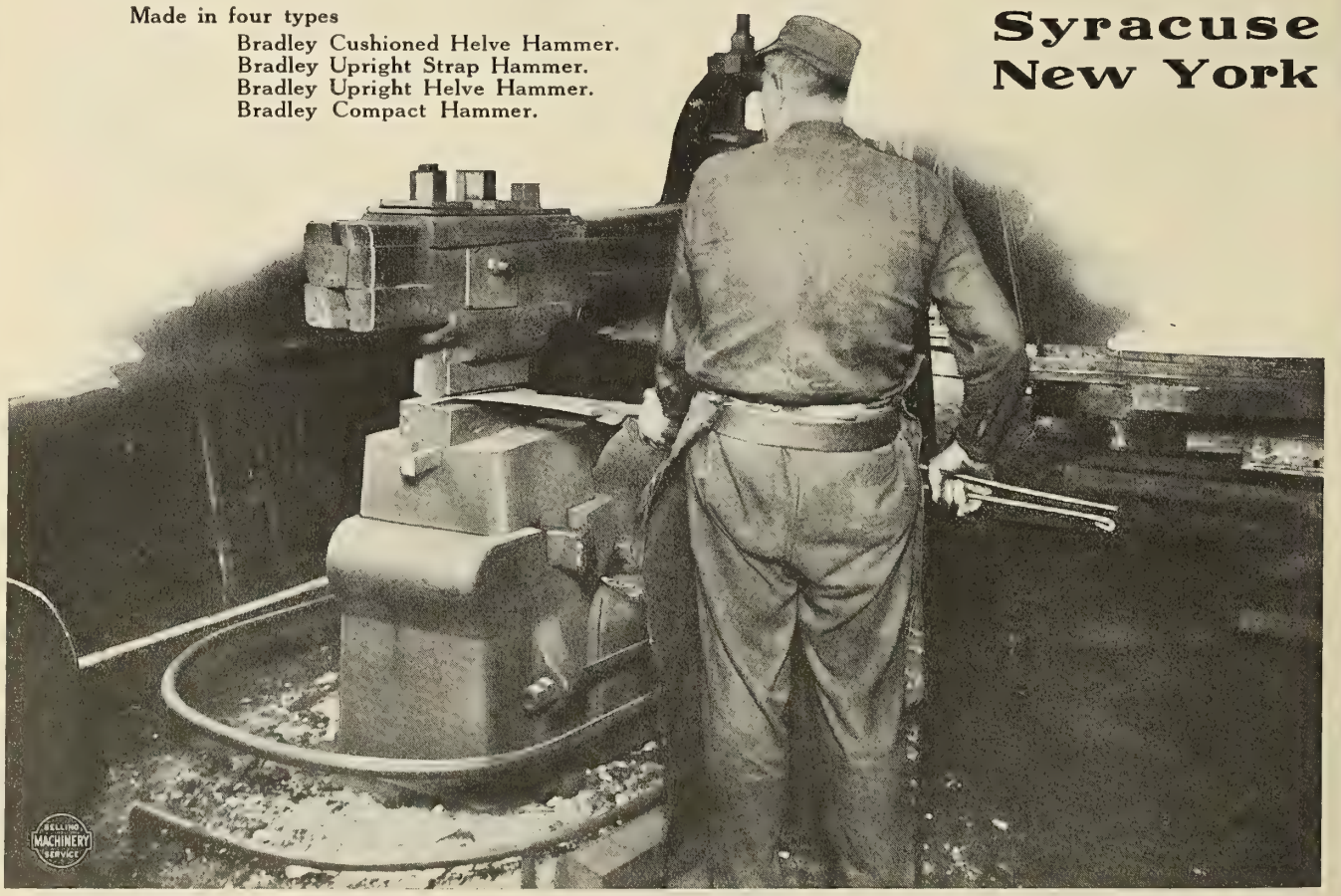
We have a series of bulletins describing our **Bradley Hammers**—Belt and Motor Drive—also **Bradley Forges.** We will be glad to send them in return for your postal.

C. C. BRADLEY & SON, Incorporated

Established in 1832

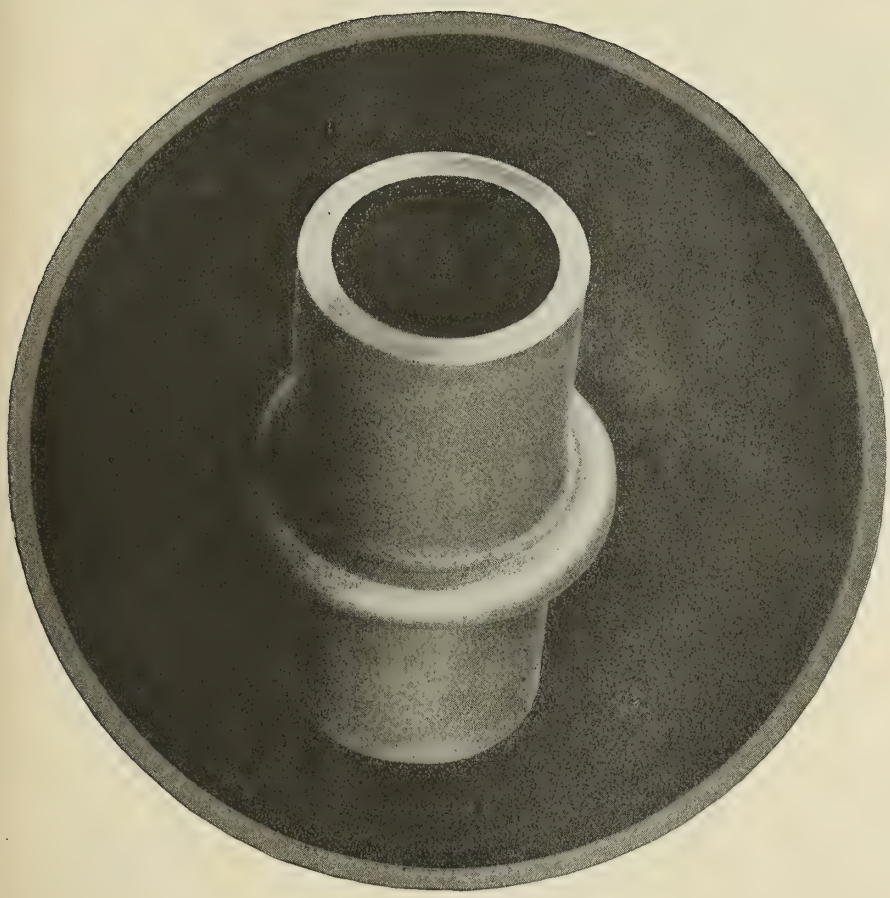
Made in four types
Bradley Cushioned Helve Hammer.
Bradley Upright Strap Hammer.
Bradley Upright Helve Hammer.
Bradley Compact Hammer.

Syracuse New York



"FORGE AHEAD WITH A BRADLEY HAMMER"

Another SCOVILL Product



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SINCE 1802

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Service SCOVILL Quality

"WEW"

on Marine Equipment Spells Safety

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Fire Extinguishers
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Life Preservers, Wire Rope Hawsers, Hoisting and Rigging Wires

We carry largest stock of ship supplies of all kinds

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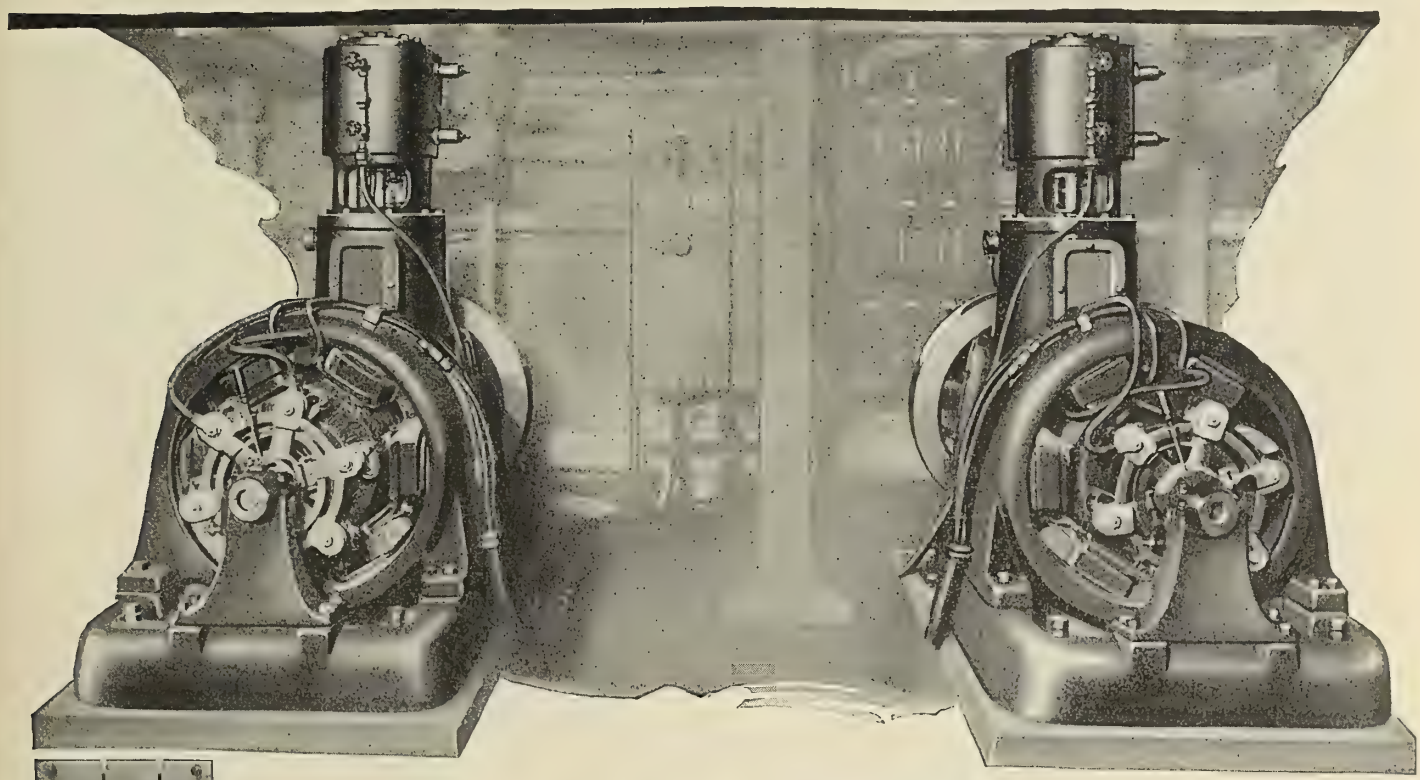
We carry full line of "WEW" Bronze and Iron Body Valves—The "WEW" is the heaviest and best Marine Valve made

Immediate Deliveries made by Our Own Motor Trucks

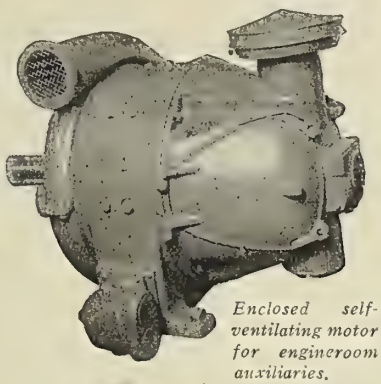
WILLIAM E. WILLIAMS

62 FRONT STREET, NEW YORK

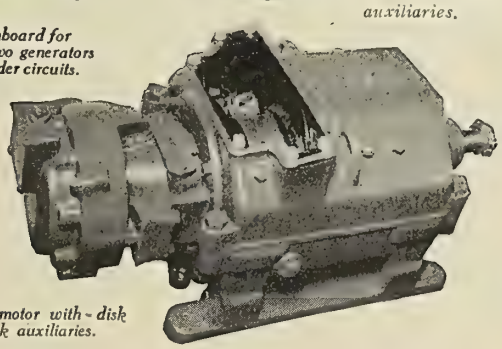
Auxiliary power that is economical, reliable and easy to obtain is as important to a ship as good tools are to a skilled craftsman.



DC switchboard for controlling two generators and 12 feeder circuits.



Enclosed self-ventilating motor for engineroom auxiliaries.



Waterproof motor with disk brake for deck auxiliaries.

A mechanical first-mate

QUICK, always-ready, willing, and fit for a little more than its job—that is the G-E Steam Engine-Driven Generating Set for marine use to light ship and drive auxiliaries.

Its insistent, steady power, its capacity for bearing emergency overloads, its refusal to fail under severe strains, all mean swift loading and unloading when hours in port are costly. Its cleanliness, low maintenance cost and easy control mean better ship operation.

A G-E Steam Engine-Driven Generating Set is not a makeshift combination of "any engine hooked up to some kind of generator" producing makeshift results. The whole unit is built and tested as a unit by a company which has put reliability and ruggedness into all sorts of electric power machinery for a quarter century.

There is a G-E Steam Engine-Driven Generating Set ready to be your mechanical first-mate on board ship.

A request brings Bulletin 42300-A describing sets ranging from 2½ to 75 Kw. capacity.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

43 502

The Yale Way Saves $362.12 in One Week

TIME studies made in the foundry where this photograph was taken showed that the total cost of handling 600 tons of sand in the old way (wheelbarrows) was $545.72.

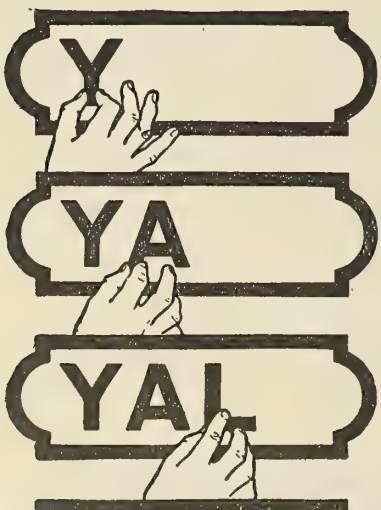
The job involved the handling of moulding sand from a railroad siding to the moulding room; 400 ft. the round trip, 40 feet of which was on a 12% grade. Six days in all were required to complete the work.

With a Yale DF-60 Electric Industrial Truck, equipped with a detachable dump-body of 27 cu. ft. capacity, the cost of handling a second 600 tons of sand was cut to $183.60, including due allowance for interest on the investment—a clear saving of $362.12.

And when this work was done, the detachable dump-body was removed to permit the truck to be used for general hauling purposes around the plant.

Other units of the Yale Hoisting and Conveying Systems include Chain Blocks, Electric Hoists, I-Beam Trolley Systems, Electric Crane Trucks and Tractor and Trailer Trains.

Have your secretary write for other bulletins today.

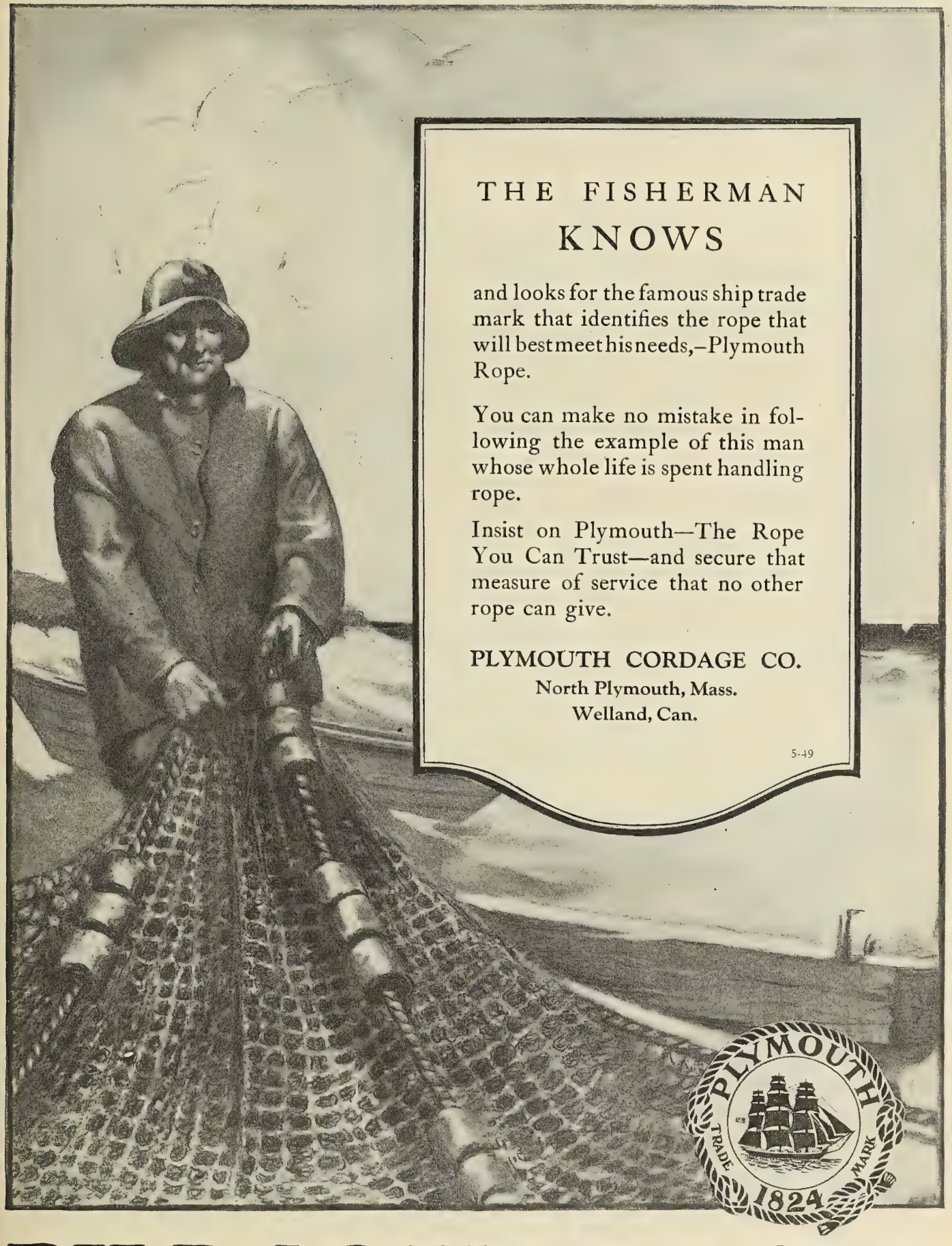


Yale Made is Yale Marked

The Yale & Towne Mfg. Co.

Stamford, Conn., U. S. A.

YALE TRADE MARK Hoisting and Conveying Systems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and looks for the famous ship trade mark that identifies the rope that will best meet his needs,–Plymouth Rope.
You can make no mistake in following the example of this man whose whole life is spent handling rope.
Insist on Plymouth—The Rope You Can Trust—and secure that measure of service that no other rope can give.
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North Plymouth, Mass.
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PLYMOUTH
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1824

PLYMOUTH ROPE

POLLAK

FORGINGS

Engine Shafts, Cam Shafts,
Rotor Shafts
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Plain Carbon or Alloy Steel

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Every operation is so performed as to insure so far as is humanly possible the lasting service of every Forging turned out from our Works.

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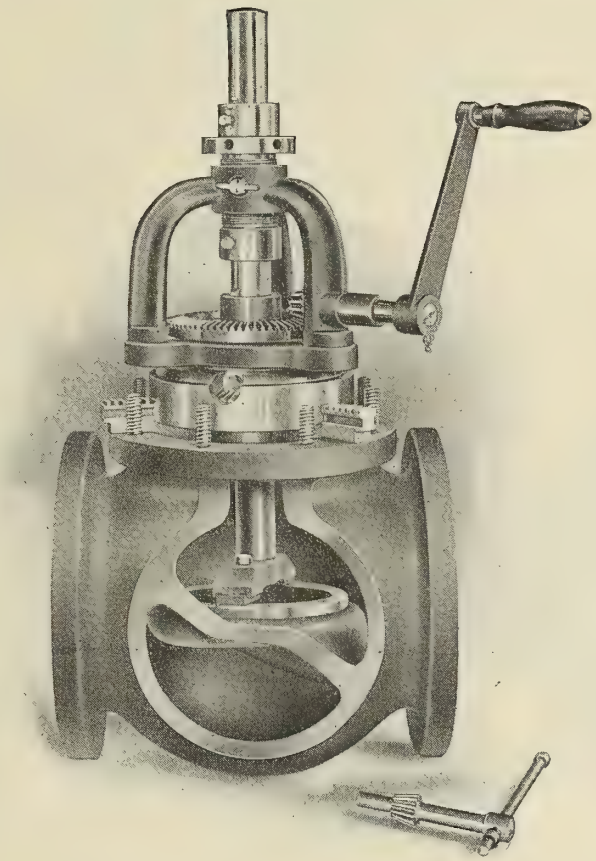
JUST A WORD
About Dexter Valve Reseating Machines

Although there are many things useful on board ship, there is nothing more useful, more essential or better known by Marine Engineers.

Every time you reseat a valve on the line you have saved the expense and bother of removing the valve. This saving in itself will very quickly pay for a Dexter outfit and you have the satisfaction of knowing that your valves are not wasting steam.



There is no other investment as profitable as a Dexter Globe, Gate or Pump Valve Reseating Outfit.

Can you be contented to be without a Dexter equipment any longer?

Send for our new Catalog M-23 or make up your requisition today.

Do it now.

THE LEAVITT MACHINE COMPANY

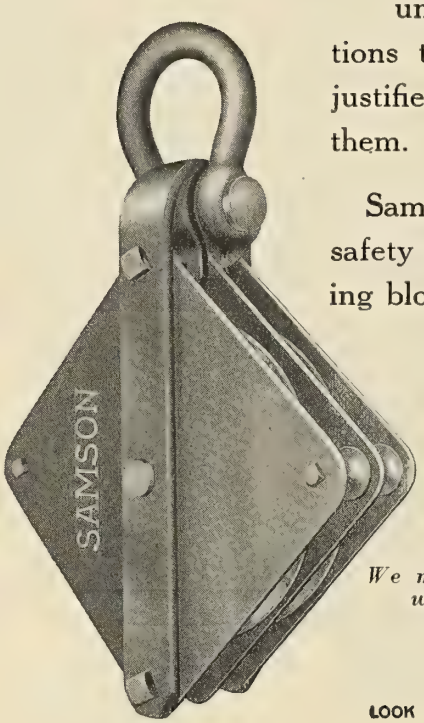
ORANGE, MASS., U. S. A.

Manufacturers of Dexter Globe, Gate, and Pump Valve Reseating Machines

SAMSON

DIAMOND PATTERN WIRE ROPE BLOCKS

QUALITY UNSURPASSED



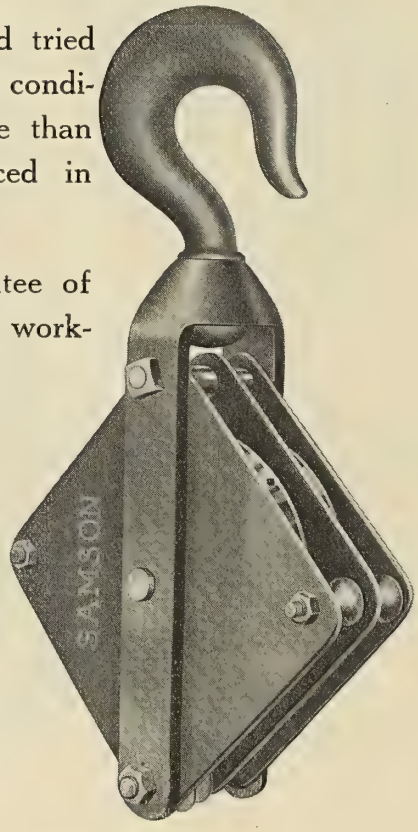
THOROUGHLY tested and tried under the most adverse conditions these blocks have more than justified the confidence placed in them.

Samson brand is a guarantee of safety securing and a smooth working block.

Jappaned or galvanized with all styles of fittings.

New prices were established May 2. Send for them today.

We manufacture a complete line of wood and steel tackle blocks.



LOOK FOR TORRINGTON U.S.A. UNION & HARDWARE CONN. THIS BRAND

WHERE OTHER BLOCKS REFUSE THE TASK *SAMSON* WILL PULL YOU THROUGH

UNION HARDWARE COMPANY

TORRINGTON, CONN.

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LUKENS

LUKENS

Did You Lose It?

or

Didn't You Ever Have One?

We're speaking about that little card which all boat builders, designers and marine engineers should have.

As one Marine Engineer said,

"Had plates of the width you are now rolling been available in the past, much complex, expensive and troublesome Scotch boiler construction could have been avoided."

If you haven't one of our size cards just let us know and we will be glad to supply you, for we roll the widest plates in the world and flange 15′ 3″ Outside diameter boiler heads in one piece.

Think of all the troublesome, leaky seams you can cut out in construction.

Yes Sir, You'll Need Our Size Card

Lukens Steel Company

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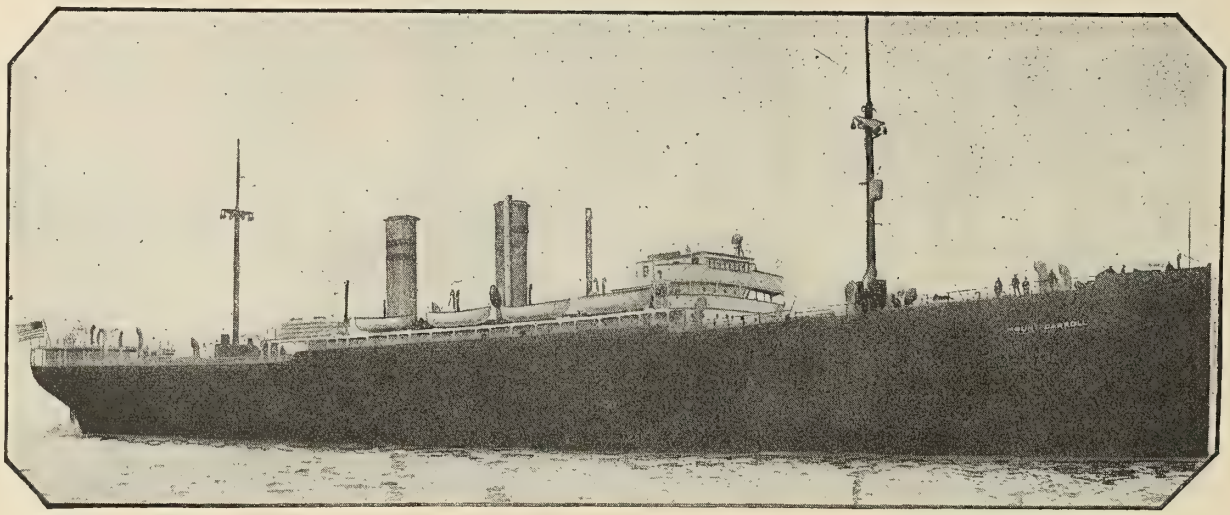
SOLE EXPORTER OF OUR COMMERCIAL PRODUCTS CONSTEEL CONSOLIDATED STEEL CORPORATION 25 BROADWAY, NEW YORK, U.S.A.

THE SHIPYARD WITH A TRADITION—FOUNDED IN 1859



S.S. Mt. Carroll, Combination Freight and Passenger ship built at the Merchant Yard for the Shawmut S.S. Company, and operated in the New York-Hamburg service by the United American Lines

Ships-Steel

We Build—Fabricate—Construct

A SIXTY-YEAR record of fine performance stands back of our shipbuilding plant. Ships built in the Chester Yard are known throughout the world for craftsmanship and durability.

Old shipbuilders know the part played in American shipbuilding by John Roach, once the head of this yard. John Roach said to his men, "Do your work so well that it will never merit adverse criticism." This is still our tradition.

To utilize further the extensive facilities of our splendid plant, we are also operating a department for general engineering and steel construction.

We are ready to place at the disposal of those contemplating work in these lines, the services of our experienced and specialized technical staff.

Our Quotations will interest you

MERCHANT
SHIPBUILDING CORPORATION

Chester, Pa., or 39 Broadway, New York

Ask us to bid on the following:

Ship Construction

Designs ready for Tankers of 10,000 D. W. T. All kinds of ships up to 15,000 D. W. T. Motorships 11,500 D. W. T. with Diesel Engines. Conversion of Steamships to Diesel Motorships with Direct or Electric Drive. Repairs and Reconditioning of Ships.

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Structural Building and Bridge Material. Structural Steel for Cranes and Tunnel Sections. Water Towers—Hoppers. Acetylene Work—Plate Shop Work—Air Ducts. Fire Escapes — Ladders—Gratings. Steel Smokestacks. Riveted Steel Piping—Pipe Expansion Bends. Gas and Oil Tanks. Equipment for Cargo Handling—Grain Elevators—Ship and Railroad Terminal Appliances.

Coppersmith Work

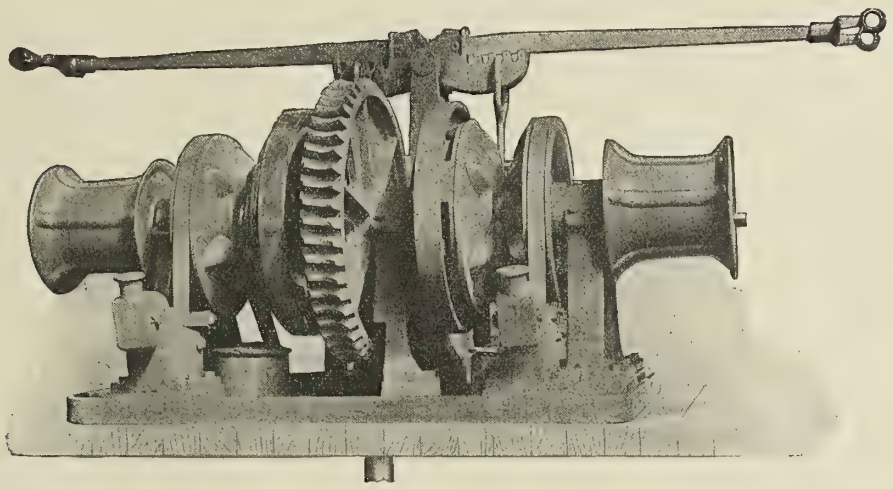
Carpenter Work

Cooling Towers

Joiner Work

All kinds of Joiner and Cabinet Work.

When You Choose That Windlass



CHOOSE A-E-CO

BECAUSE

Among the Many Types and Sizes Built by the American Engineering Company, There Is One That Will Suit

Your Space Limitations

Your Ship Construction

Your Personal Preferences

and

BECAUSE

Its Design and Quality Will Guarantee

Satisfaction
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Strength
Dependability
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We illustrate the worm-gear type with drive (steam or electric) in protected space below deck.

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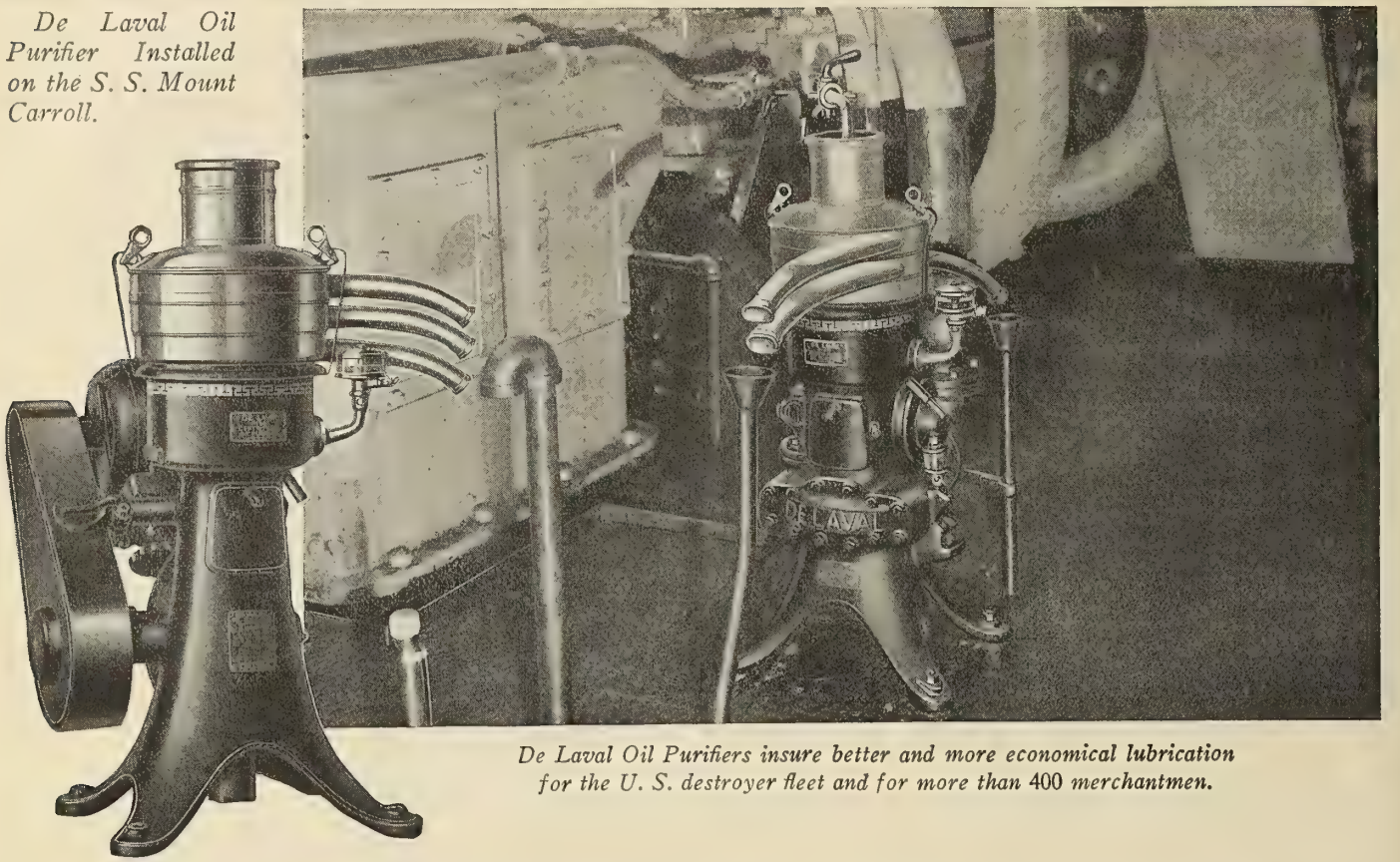
THE AMERICAN ENGINEERING COMPANY
PHILADELPHIA

De Laval Oil Purifier Installed on the S. S. Mount Carroll.



De Laval Oil Purifiers insure better and more economical lubrication for the U. S. destroyer fleet and for more than 400 merchantmen.

Cleaner lubricating oil helps to reduce operating expenses of the Mount Carroll

The De Laval Oil Purifier on board the S. S. Mount Carroll removes from the used lubricating oil the dirt, water and particles of metal which are ruinous to bearings. It makes it possible to use the same oil over and over and so greatly reduces lubricating costs.

Oil purified by the De Laval is kept free from emulsion and for lubricating purposes is equal to new oil. A constant, abundant supply of such oil insures a greater length of service from machinery and a minimum of bearing trouble.

De Laval Bulletins No. 102-E and No. 103-E tell how you can save oil. Write for them.

The De Laval Separator Company

Largest Manufacturers of Centrifugal Machinery in the World

New York, 165 Broadway **Chicago, 29 East Madison St.**

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Chadburn's (Ship) Telegraph Company, Ltd., Cyprus Road, Bootle, Liverpool
Turbine Equipment Company, Toronto, Ontario, Canada

Sooner or later you will use a De Laval

FLOODLIGHTS

Floodlights Speed up Dry Dock Work

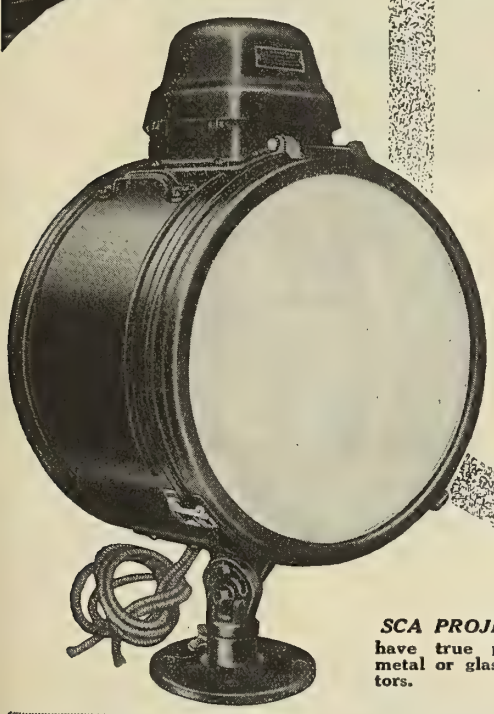
BY the use of SCA Imperial Floodlight Projectors emergency repair or construction work can be done at night under daylight conditions.

These Projectors are mounted on 360° swivel bases and quadrants which permit any desired elevation or depression.

Ventilated casings are of highest rust resisting quality iron or steel, alloy-coated, japanned and baked. Baffles prevent direct air from striking lamp.

These SCA Imperial Floodlight Projectors can be focused without tools to give narrow or wide beams as desired. They are equipped with plain heat resisting, spread or diffusing lenses, and with any one of several special forms of mounting.

Send for Imperial Floodlight Bulletin No. 304 and No. 304-A.



SCA PROJECTORS have true parabolic metal or glass reflectors.

CROUSE-HINDS COMPANY
SYRACUSE, N. Y., U. S. A.
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Condulets Panelboards
Knife Switches Floodlights
Guy Anchors
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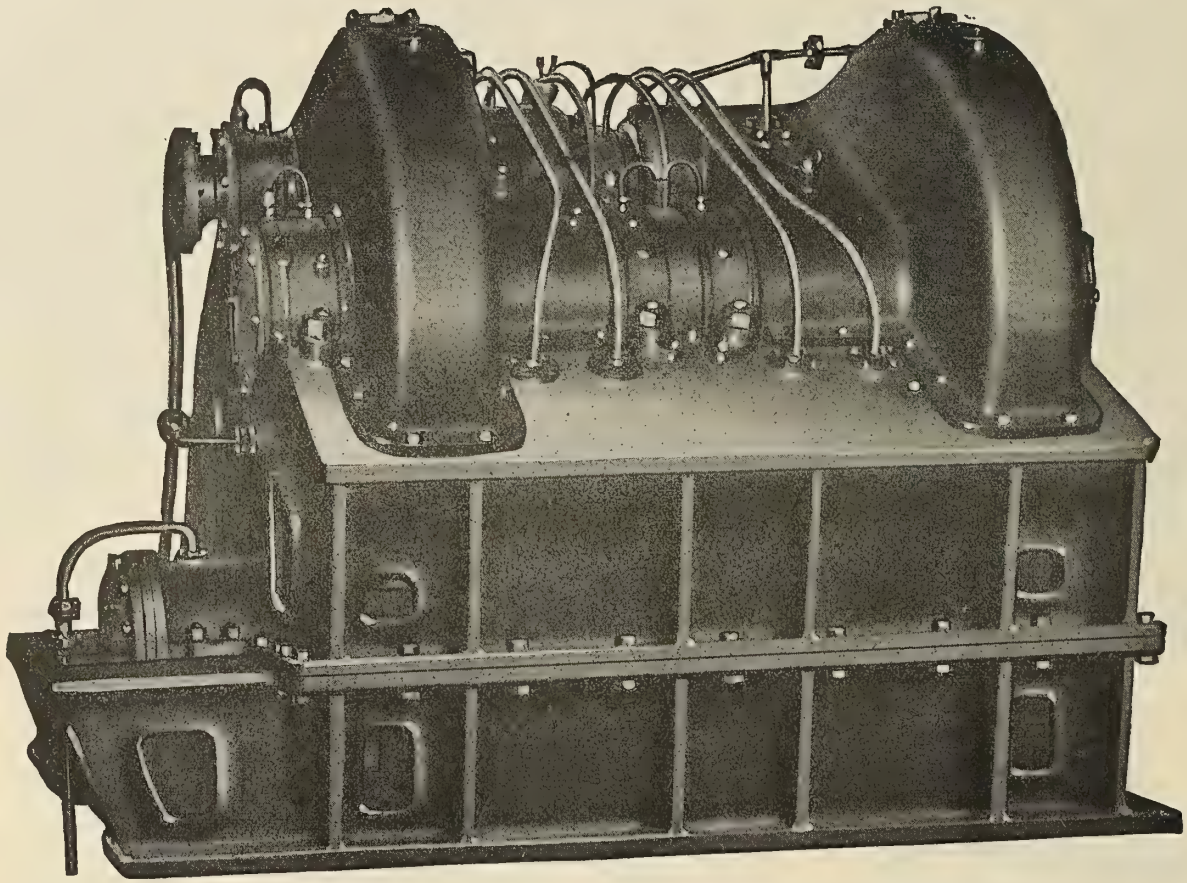
CROUSE-HINDS

FALK Herringbone GEARS

For MARINE SERVICE



Side View of Double Reduction Marine Gear for Single Turbine Drive,
1500 H. P., 3600 to 90 R. P. M., including Kingsbury Thrust Bearing

These gear units are built in the Largest and most Completely Equipped Plant in this country which is devoted exclusively to the building of high class reduction gears—for all purposes

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1007 Park Bldg., Pittsburgh, Pa.

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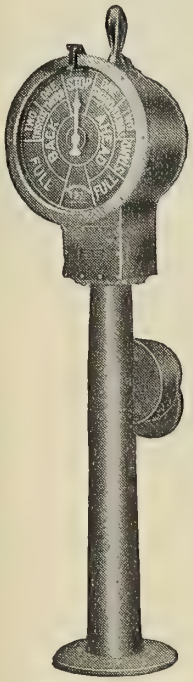
ENGINEERING EQUIPMENT CO., Ltd.
263 St. James Street, Montreal, Quebec, Can.

12

MARINE ELECTRICAL EQUIPMENTS

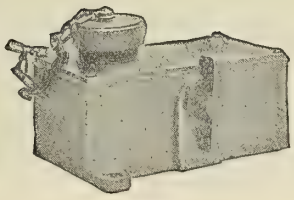
TELEGRAPHS *for* SHIPS YACHTS MOTOR BOATS



Electrical 1550

LIGHTING FIXTURES
AND
WIRING APPLIANCES

2558



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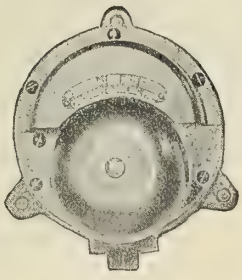

781

Mechanical 771-S

ANNUNCIATORS
BOILER FIRE TIMING
CALL BELLS, W. T.

DRY-DOCK CONTROL SYSTEMS, ENGINE SPEED AND DIRECTION INDICATORS, FIRE ALARM SYSTEMS

JINGLE BELLS
BELL PULLS, OIL AND WATER INDICATORS
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ENGINE
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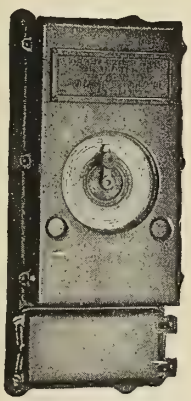
REVOLUTION.

VOICE TUBES AND FITTINGS, ELECTRIC WHISTLE CONTROL SYSTEMS.



Boiler Fire Timing Transmitter 3019

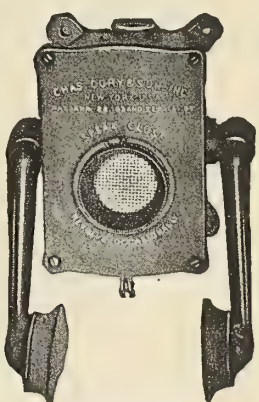
ORIGINATORS AND DESIGNERS OF
INTER-COMMUNICATING SYSTEMS
FOR NAVAL AND MERCHANT VESSELS

Mfr's of the

RAMSAY MARINE GOVERNOR

THE PERFECT ANTICIPATING AND EMERGENCY SYSTEM FOR CONTROLLING MARINE ENGINES UNDER ALL CONDITIONS.

WRITE FOR DESCRIPTION 64-7.



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183-187 Varick St.
Main Office and Factory

PHILADELPHIA
207 Market St.

SEATTLE
515 Hoge Building

SAN FRANCISCO
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48-10 AIR HOSE

In Constant Service Where Ships are Built

A tough rubber cover built to withstand abrasion and offering the greatest resistance to wear—

An oil-proof inner tube which cannot separate from the braid—

An extreme strength resulting in unusual length of service, yet so flexible that it will easily bend around any obstruction without kinking—

All characteristic of 48-10 the most dependable air hose that it is possible to produce.

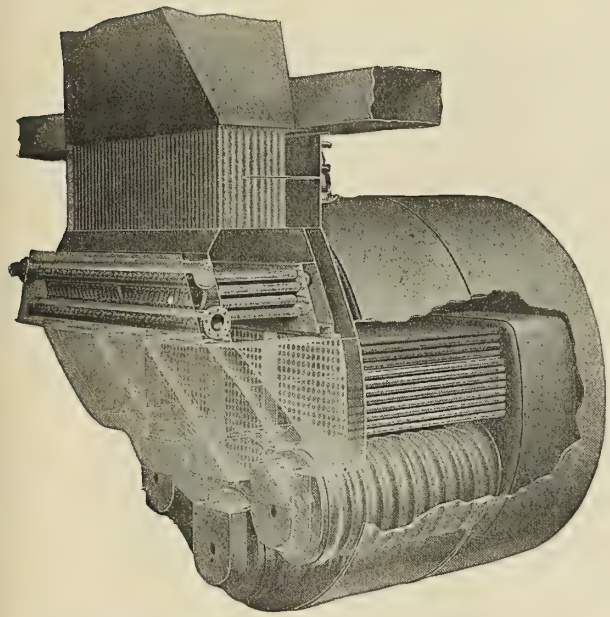
United States Rubber Company

1790 Broadway **New York**

Branches in Every Industrial Center

UNITED STATES RUBBER COMPANY US RUBBER SYSTEM AND ASSOCIATED COMPANIES

How Foster Superheaters Affect Main Engine Economy



Foster Superheater Installed in Uptake of Scotch Boiler

Foster Superheaters have by now been thoroughly tested out in connection with both triple expansion engines and turbines aboard ship.

For example, over 100 ocean-going and coast-wise merchant ships equipped with Scotch marine boilers and triple expansion engines are fitted with Foster waste-heat type superheaters in uptakes. Many of these installations have been subjected to exhaustive tests with and without superheaters. As a result, the following points in connection with the use of moderate superheat in reciprocating engines have been definitely established:

No change in design of valves, clearances or port areas is required for satisfactory operation.

Internal lubrication is unnecessary.

Repairs to engines are no more frequent, and repairs to superheaters are literally negligible.

The average fuel economy is improved from 5 to 10 per cent—enough to repay the cost of the superheater in 2 to 3 years.

The advantages of superheat in turbine operation are universally accepted. Both land and marine experience has definitely proven that superheat is *required* to produce the proper turbine efficiency and to eliminate blade troubles and repairs due to moisture entering the turbine.

The benefits of superheat in marine service have been largely established by Foster Superheaters. Over 20 years of experience and the satisfactory results of 10,000 installations on land and sea entitle us to speak authoritatively. Write for complete information.

43

POWER SPECIALTY COMPANY

111 BROADWAY, NEW YORK

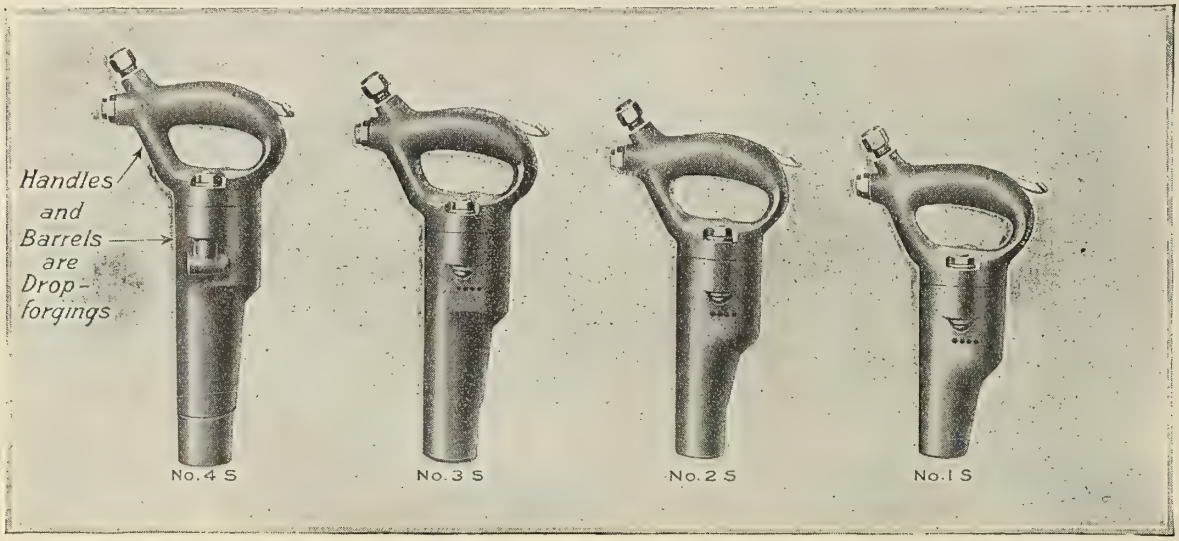
Branches: Boston, 50 Congress Street; Philadelphia, Land Title Building; Pittsburgh, Oliver Building; Chicago, Harris Trust Building; San Francisco, Balboa Building.

Agencies: Norfolk, T. J. Egan Co.; New Orleans, Marine Supply Company; Galveston, Neptune Ship Chandlery Company.

Works: Dansville, N. Y., and Egham, Eng.

FOSTER SUPERHEATERS

LET THESE HUSKY TOOLS WORK FOR YOU



"Little David" Chippers Cut Metal and Costs

They have the extra power needed to cut more metal and the special features which avoid breakdowns and interruptions to the work.

They cost little to maintain. For instance in one large plant "Little David" Chippers averaging two years old and in daily use, cost only 31 cents per month for upkeep. This figure included labor costs and was based on tools actually in everyday use.

Let us send you Catalog 8000 describing these tools or ask our representative to call.

PRICE OIL ENGINES

Ingersoll-Rand Company

General Offices

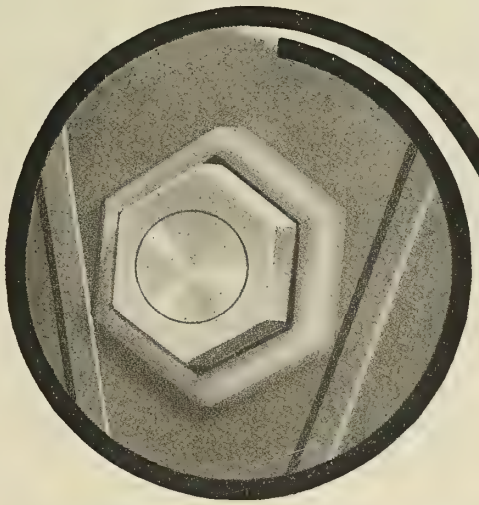
11 Broadway, New York

Ingersoll-Rand

213-PT

MADESCO PRODUCTS

MARINE DECKING & SUPPLY CO. MADESCO PRODUCTS PHILADELPHIA, PA.



This shows our patent Nut Lock in detail

"Send for folder"

Madesco
Quaker
The
Cargo Hoister
with the
PATENT
Nut Lock

OTHER FEATURES—

The over-sized Pin
The flanged bushing
The drop forged straps, head shackles.

COTTER PINS
Eliminated

Absence of cotter pins means absence of trouble and delay.

Sailors seldom replace cotter pins.

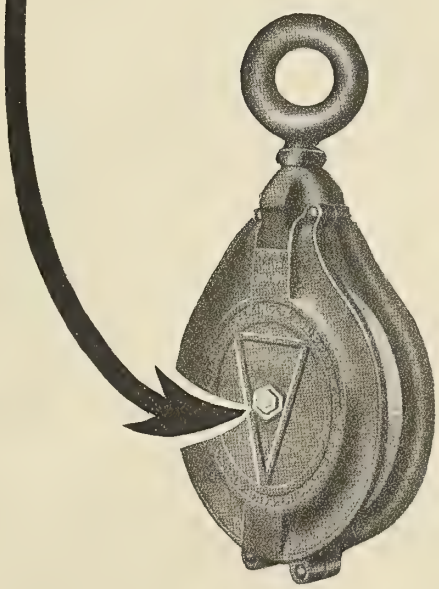
The patent nut lock feature is found only on blocks made by

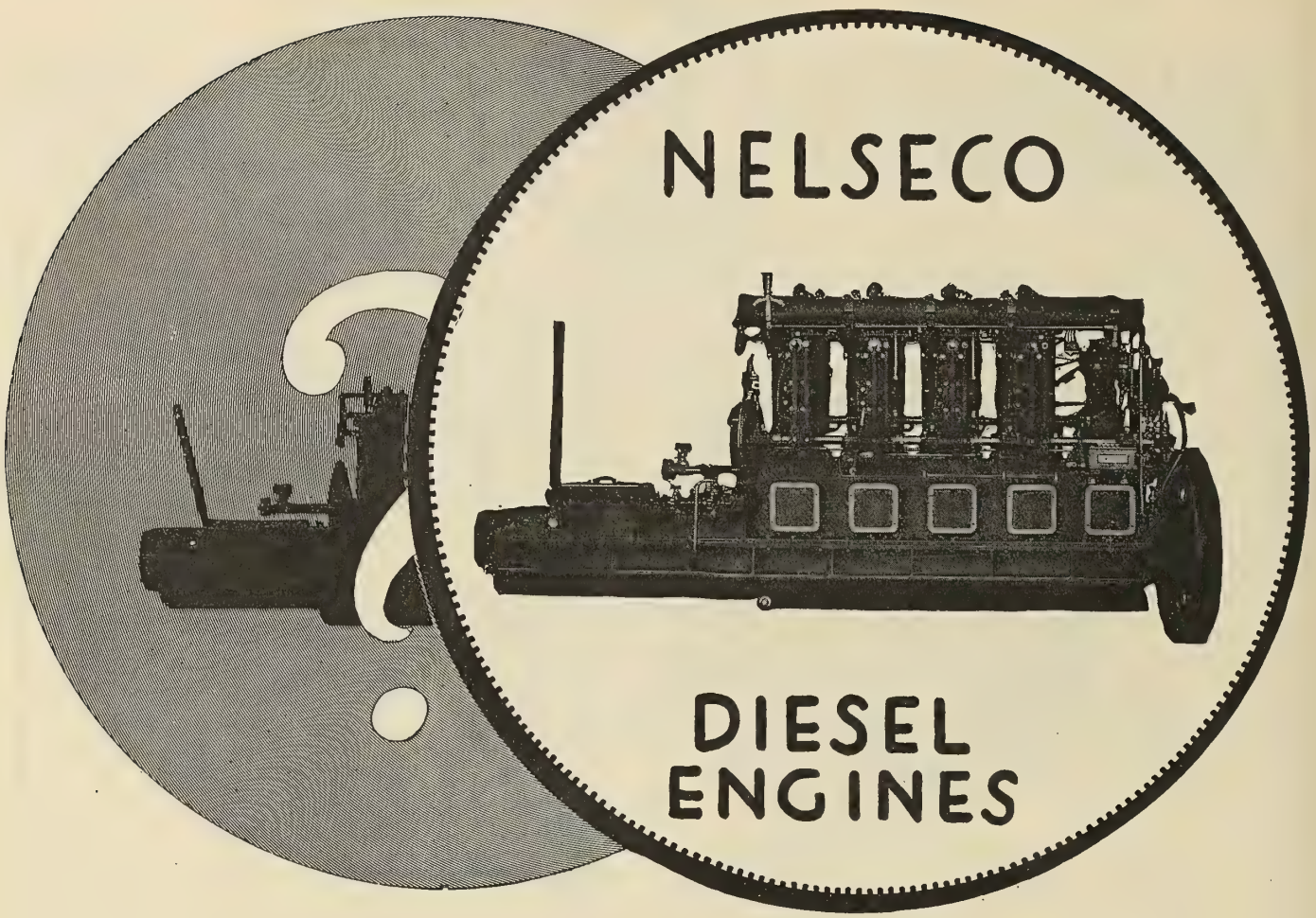
Marine Decking & Supply Co.

Main Office
116 N. Delaware Ave., Philadelphia, Pa.

Factory: **Easton, Pa.**

New York Distributors
Coston Supply Co., 59 Front Steeet





Certainty—

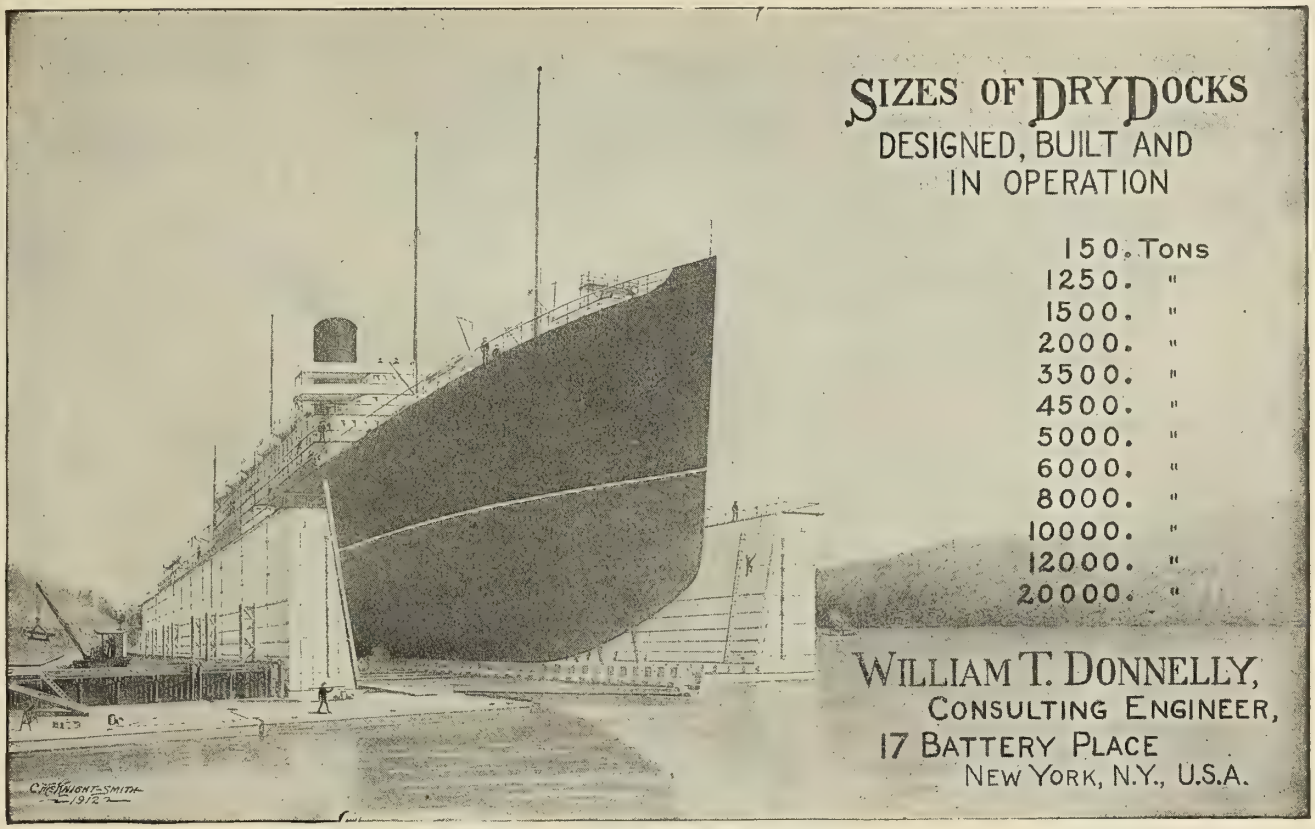
THE SHADOW OF DOUBT
NEVER ENTERS THE MIND OF USERS
OF
NELSECO
MARINE DIESEL ENGINES

GOLD MEDAL
HIGHEST AWARD
MARINE DIESEL ENGINES
Panama-Pacific Exposition

Ships thus equipped are propelled efficiently and dependably with as low fuel consumption as is possible to secure through any like operation. Over 150,000 H. P. now in service in American and Foreign Vessels or on order.

Sizes: 120, 180, 240, 360, 480 to 2000 B.H.P.

NEW LONDON SHIP & ENGINE CO., Groton, Conn., U. S. A.



20,000 TON FLOATING DRY DOCK DESIGNED FOR THE BETHLEHEM SHIPBUILDING CORPORATION AT SPARROW'S POINT, MD., HAS PROVED HIGHLY SUCCESSFUL.

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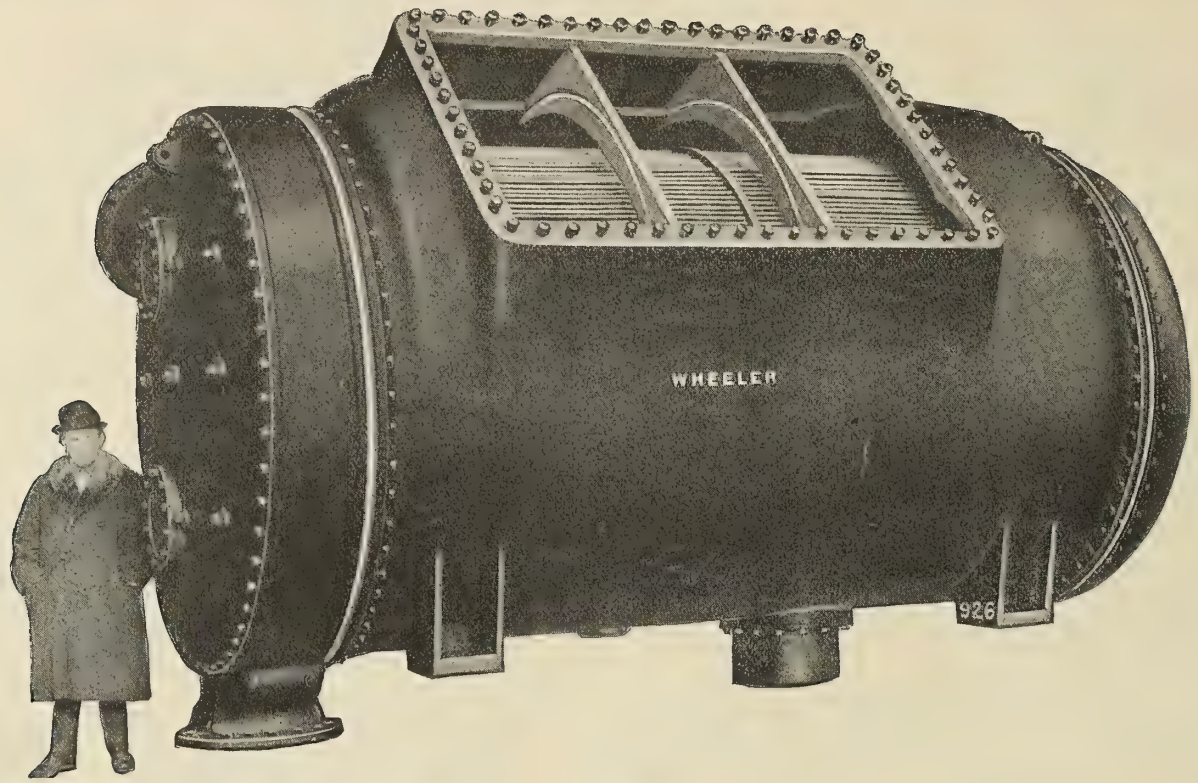

WHEELER

MARINE CONDENSING EQUIPMENT

WHEELER Admiralty condensers are designed to produce the highest rates of heat transmission and the maximum condensate temperature. The entering steam is distributed circumferentially around the top of the tube bank, thus insuring uniform penetration of all of the tubes.

Wheeler Admiralty condensers are built in all sizes for main unit and auxiliary service. They are furnished mounted directly over combined auxiliary pumps or with independent air, circulating and condensate pumps, as for high vacuums.

We have developed all types of vacuum pumps in connection with Wheeler Condensers. The Wheleer-Edwards air pumps are standard equipment on ships equipped with reciprocating engines, because of their proven reliability and low operating cost. For high vacuum turbine work, where space is limited and the highest economy of steam is desired, the new Wheeler two-stage steam jet air pump has no equal.

Each Wheeler Condensing installation is especially designed on scientific principles to meet specific conditions and requirements.

Bulletin on request.

Wheeler Condenser & Engineering Co.

CARTERET, NEW JERSEY

Manufacturers of condensers, circulating pumps, vacuum pumps, evaporating systems, brass and copper tubes and pipe.

See our exhibit at the Seventh National Exposition of Chemical Industries, New York City, during the week beginning September 12th.

149

LUNKENHEIMER

"Victor" Gate Valves

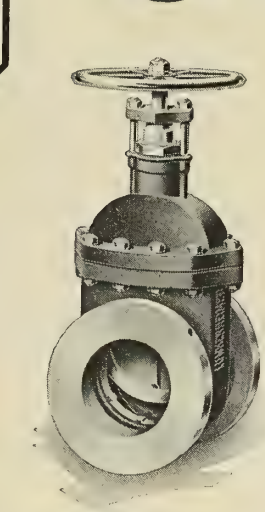

Fig. 941.
Iron Body Bronze Mounted.
For pressures up to 125 lbs.

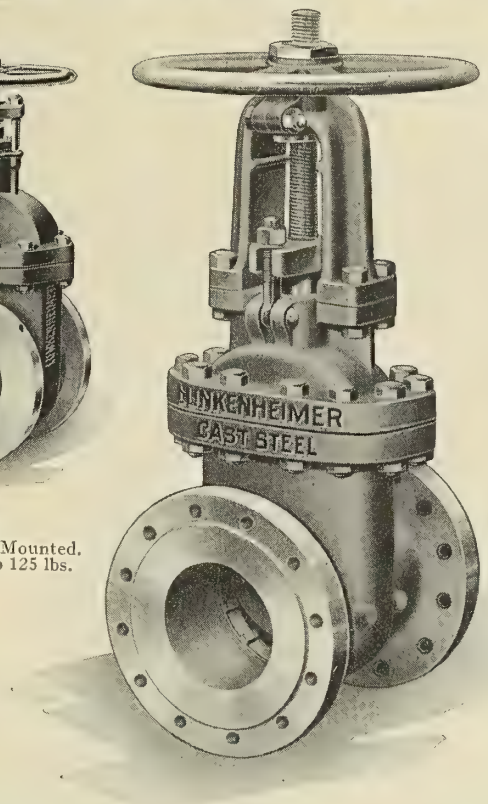

Fig. 1353.
Cast Steel. For pressures up to 350 lbs.

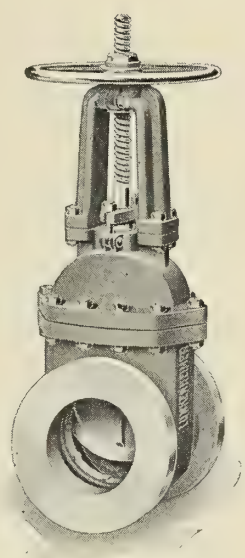

Fig. 787.
Bronze. For pressures up to 250 lbs.

Dependable performance is the service record of LUNKENHEIMER "VICTOR" GATE VALVES. The Lunkenheimer solid wedge disc, double-faced and guided in its travel, is the most practical design of Gate Valve construction. It eliminates "dragging" across the seatring faces and the consequent wear prevalent in valves employing loose parts.

Highest quality materials, coupled with the Lunkenheimer method of manufacture; bearings bushed to minimize wear; all parts, including the seatrings, renewable, and the indestructible gasket between the bonnet and body flanges, all tend to enhance their value and insure longevity.

Lunkenheimer "VICTOR" Gate Valves are made in Bronze for pressures up to 125 and 250 pounds; in Iron Body Bronze Mounted for pressures up to 100, 125, 175 and 250 pounds, and in Cast Steel for pressures up to 350 pounds and temperature to 800° F. A complete line covering every service requirement.

Lunkenheimer Distributors situated in practically every port are prepared to furnish Lunkenheimer Products from stock. Insist on having the genuine.

THE LUNKENHEIMER CO.
"QUALITY"
LARGEST MANUFACTURERS OF
HIGH GRADE ENGINEERING SPECIALTIES
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No 58
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6-23M-25

Feed Water—An Important Item of Operating Cost

Marine boilers should not have feed water troubles, such as scale, priming or repairs due to salt water. With properly designed and constructed surface condensers and evaporators, marine boiler feed water will be entirely free from scale-forming salts.

With either the Scotch or Water-tube type of boilers, it is essential that the condenser be carefully watched and the condensed feed supply be tested with a silver nitrate solution every watch to make sure that any leakage from the condenser is quickly detected.

If the condenser is found leaking it will cause less trouble to stop and repair it than to continue heavily salting the boilers. If the boilers are unavoidably salted it is best to reduce the speed of the main engine until the boilers can be freshened again, as this reduced speed will permit the boilers to operate without priming or causing troubles with lower row tubes.

Foster Marine Boilers have large water storage and ample steam disengaging surface. When fed with reasonably good feed water they will not prime. The tubes are straight throughout their entire length and can be quickly and easily cleaned with a turbine tube cleaner in port. They do not require a large scaling gang to clean them internally as is usual with all Scotch marine boilers.

There is a very complete chapter on feed water in the Foster Boiler Catalogue. Why not read it?

FOSTER MARINE BOILER CORPORATION

General Offices:

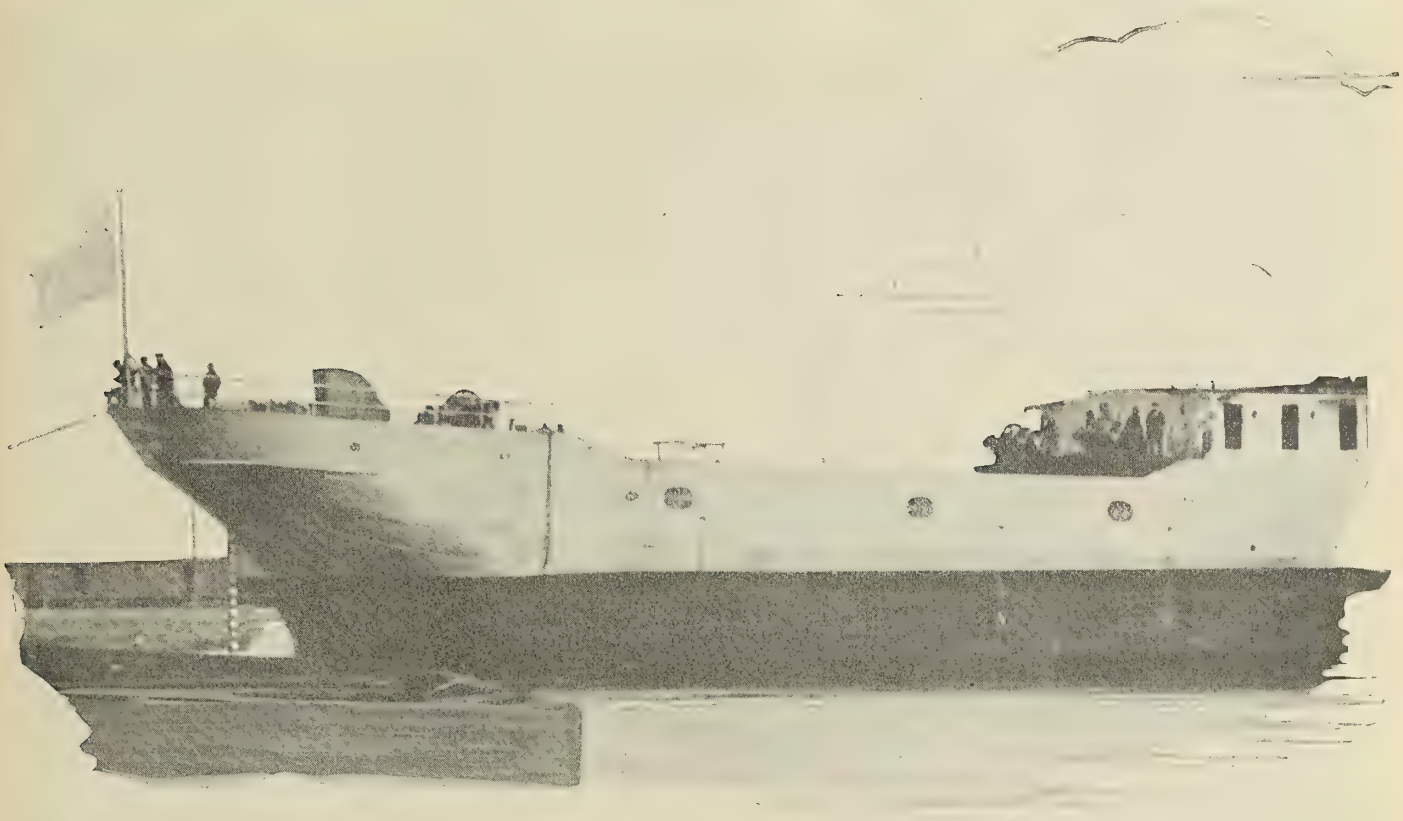
111 BROADWAY, NEW YORK

Branches: Boston, 50 Congress St.; Pittsburgh, Oliver Bldg.; Philadelphia, Land Title Bldg.; Chicago, Harris Trust Bldg.; San Francisco, Balboa Bldg.

Agencies: Norfolk, T. J. Egan Co.; New Orleans, Marine Supply Co.; Galveston, Neptune Ship Chandlery Co.

Plants at Edgemoor, Del., Oil City, Pa. Springfield, Ill., Portland, Ore.

Send for the Foster Boiler Catalog



One of many U. S. Shipping Board steel ships on which Dutch Boy Red-Lead was used for first hull coat.

Salt water destroys steel—

But red-lead saves it. That's why the men who have the responsibility of operating ships insist on red-lead for metal surfaces.

Dutch Boy Red-Lead is the best known and most economical protection for steel and iron—on ships, piers, buildings, bridges, tanks, and so forth. It covers the surface with a tough, elastic, lasting, moisture-proof coating. It is easy to put on, and it stays put, making an excellent foundation for finishing coats.

In the Navy, the first coat on all steel-work is red-lead; red-lead is used for retouching wherever rust appears; all because red-lead gives the best protection against corrosion.

Dutch Boy Red-Lead comes in convenient linseed-oil paste. It is pure, and does not harden in the pail—no red-lead wasted, no time lost.

Specify Dutch Boy Red-Lead for all metal surfaces. Can be tinted to your requirements, in black, browns and greens, for finishing coats.

Write for Painting Helps No. 6.

NATIONAL LEAD COMPANY

New York	Boston	Cincinnati	San Francisco
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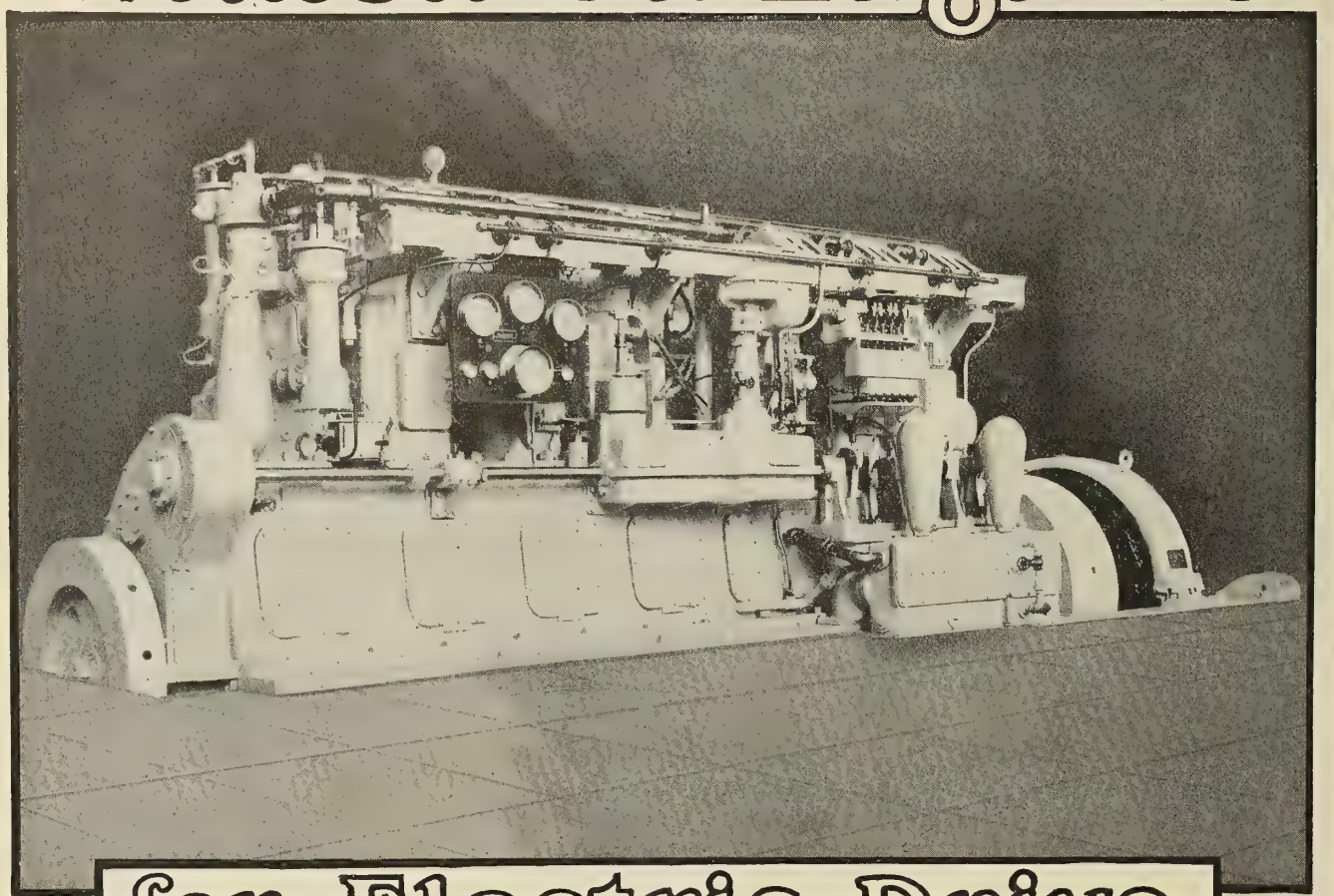
Dutch Boy Red-Lead

Winton Oil Engines



for Electric Drive

AN increasingly large number of Winton Diesel-Electric Drive Installations are being made, because these outfits are proving out in service to be splendidly efficient and extremely economical in operation.

A series of two or more Winton Oil Engines, each connected to a Westinghouse Generator, generating power and supplying it to a driving motor located in the stern, makes an ideal installation for many different types of ships. The power plant can be placed advantageously, it occupies less room than any other type of propulsion unit and requires a minimum of attention and labor. Its fuel is low in cost, easily stored and quickly taken aboard.

Write to-day for full details of Winton Diesel-Electric Drive Units and for the new Winton Catalog

WINTON ENGINE WORKS, CLEVELAND, OHIO, U. S. A.

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Washington—R. L. Fryer, 817 Albee Building
San Francisco—F. G. Bryant, 593 Market Street
Jacksonville—D. J. Carrison & Company
Seattle—H. W. Starrett, Sunset Engine Co.

Winton

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Miscellaneous bronze semi-steel and gray iron castings—grate bars, bridge-walls, hawse pipes and machined castings for all requirements aboard ship.

We are exceptionally well equipped for machining heavy pieces, such as shafting, rudder posts, propeller blades and hubs.

Ferguson-Herbert products are backed by a service that insures prompt deliveries.

The shrewdest Port Engineers have used Ferguson Service for many years. Don't delay the ship—Get in touch with us at once.

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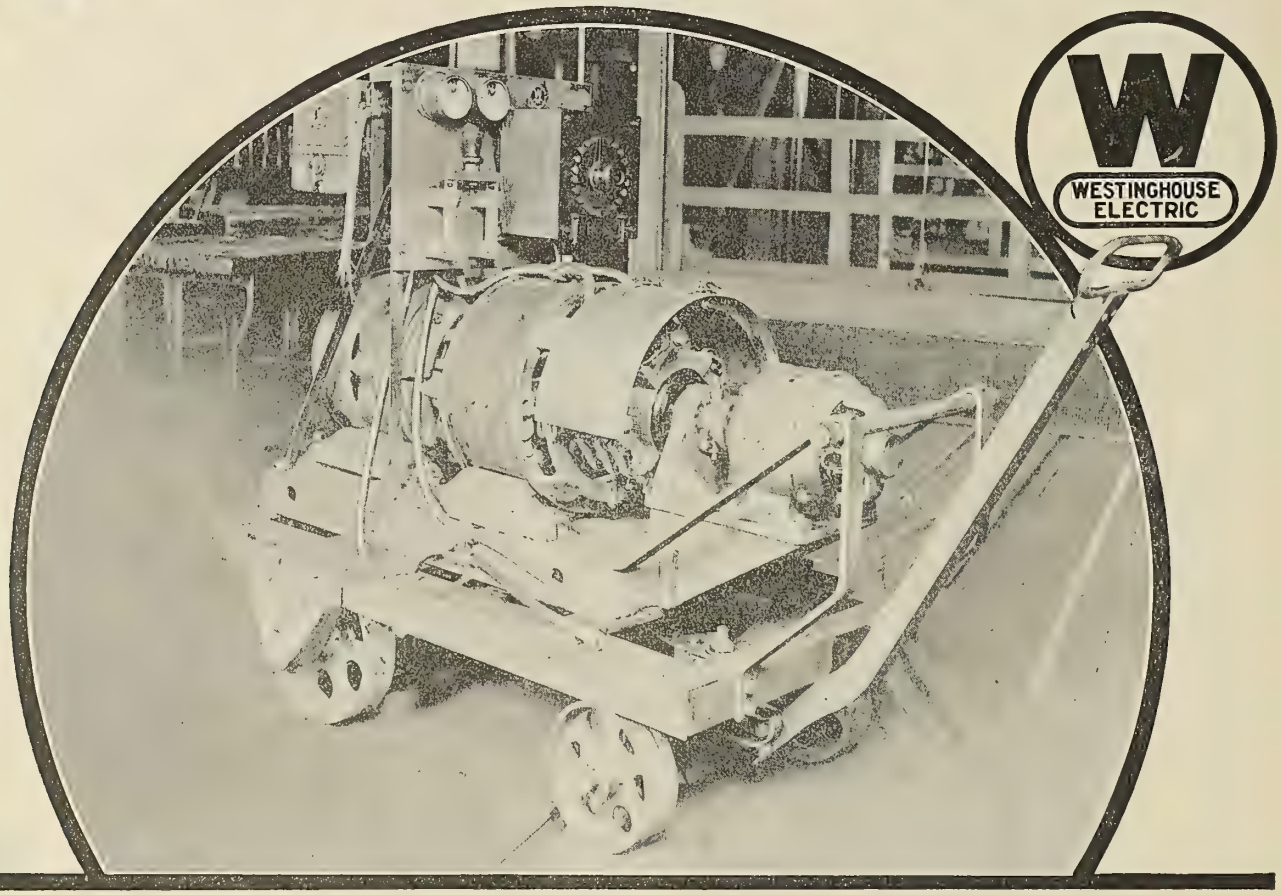

Better Fusion–Deeper Penetration and more welds per day–

Ten points of the Westinghouse welding equipment that assure economy of operation, good penetration and the proper fusion:

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2. Reactor of low inductance.
3. Proper penetration of deposited metal.
4. Small current steps less than 10 amperes.
5. Twenty-one current steps obtained by adjusting only one device; namely, field rheostat. No change in rheostat setting required while changing from downward or vertical welding to overhead welding.
6. Electrode does not have a tendency to freeze to work.
7. A-C. motor provided with outside terminals for connecting for 220 or 440 volts.
8. Control panel mounted over set, making it compact and requiring minimum floor space.
9. Ammeter and voltmeter supplied on panel. Operator can readily check current and polarity.
10. Covered generator commutator and radial self aligning ball bearings for set and exciter.

Bulletin 7149 is a valuable reference book on arc welding applications and the advantages of the Westinghouse arc welding equipment. Write for a copy.

Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa. Offices in all Principal American Cities

Arc Welders

Better Than The Law Demands

A ship wireless equipment may meet the requirements of the law, and yet it may be ten years behind the radio times.

The set which is installed on a ship by the Radio Corporation of America always embodies the highest engineering skill. It is far more efficient than the law demands—far more trustworthy. It is the result of the systematic development of wireless by the Radio Corporation of America over a period of twenty years.

Thousands of vessels are now equipped with the efficient apparatus of the Radio Corporation of America—apparatus which is better than the law demands.

The sets of the Radio Corporation of America are the most efficient that scientific skill can produce. For behind the Radio Corporation of America stand the splendidly equipped Research Laboratories of the General Electric Company, The American Telephone & Telegraph Company and The Western Electric Company, where, year in and year out, eminent physicists conduct investigations that result in new radio advances. No other company enjoys the benefit of this scientific research in the field of radio communication.

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WORLD WIDE WIRELESS

Edward J. Nally, *President*

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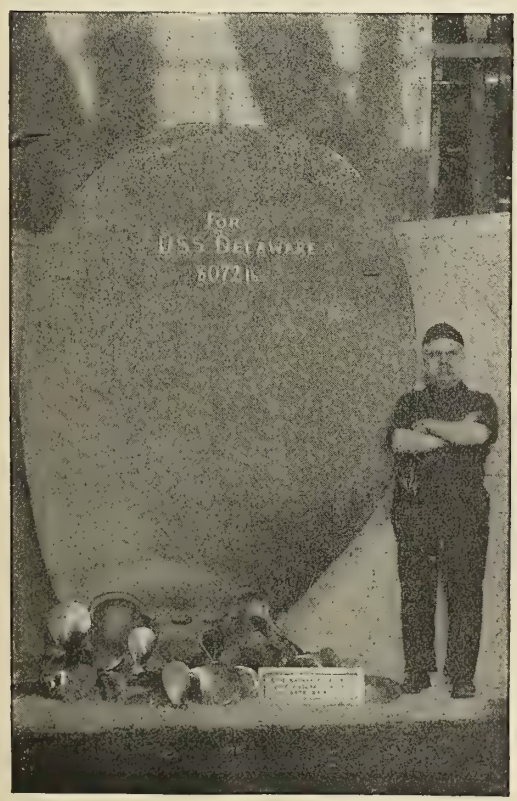

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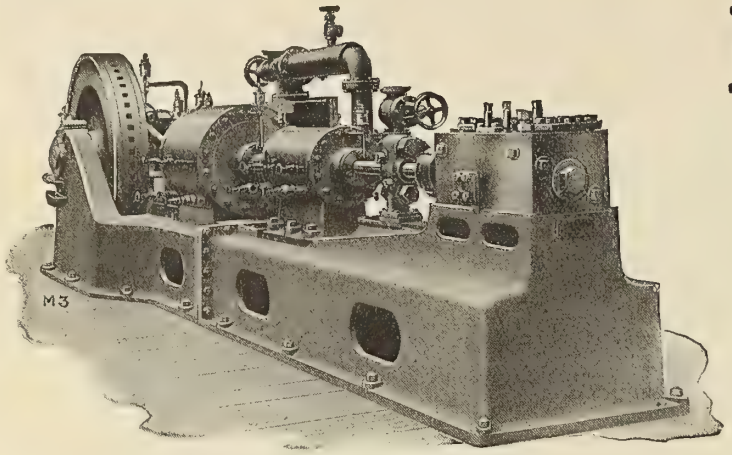

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Mechanical Refrigeration

Heavily built and reliable machinery is essential in the successful operation of the modern refrigerating plant. The Quality, Efficiency and Durability of **FRICK** Refrigerating Machinery are never questioned.

stands for better sanitary conditions, even temperatures, improvement in the quality of the goods stored and a reduction in the amount of goods lost.

CO_2 Compression and **Ammonia Compression** Refrigerating units in any size to meet requirements.

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By choosing only those publications whose circulation is accurately measured, you not only practice economy in your advertising, but are assured that your money is buying a definite quantity of circulation.

MARINE ENGINEERING'S circulation is measured by the Audit Bureau of Circulations. Advertising placed in its columns is an economical investment.

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Charcoal Iron Boiler Tubes

Much Depends on Boiler Tubes

What does boiler tube failure mean?

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More than that. It means tying up a boiler, perhaps the ship, while costly overhead runs on and revenue-bringing cargo waits, or is lost.

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PARKESBURG, PA.

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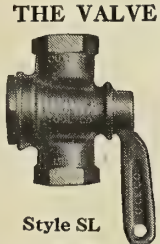
PRESSURE-SEATED AIR VALVES

THE VALVE THAT NEVER LEAKS

Cleco Valves improve with use; they do not require any attention after installation.
Cleco Valves are made in sizes to suit all requirements from ¼-in. to 2-in. outlets.
Cleco Valves fill all requirements between Air Compressor and Air Tools.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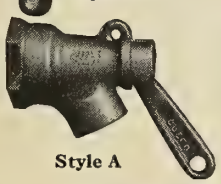
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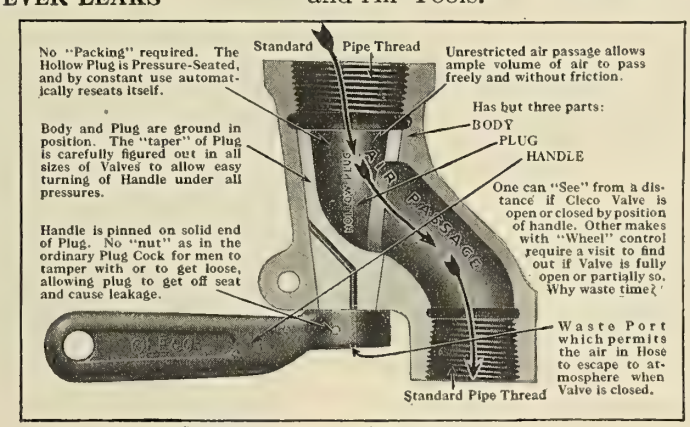
No "Packing" required. The Hollow Plug is Pressure-Seated, and by constant use automatically reseats itself.
Body and Plug are ground in position. The "taper" of Plug is carefully figured out in all sizes of Valves to allow easy turning of Handle under all pressures.
Handle is pinned on solid end of Plug. No "nut" as in the ordinary Plug Cock for men to tamper with or to get loose, allowing plug to get off seat and cause leakage.
Standard Pipe Thread
Unrestricted air passage allows ample volume of air to pass freely and without friction.
Has but three parts:
BODY
PLUG
HANDLE
One can "See" from a distance if Cleco Valve is open or closed by position of handle. Other makes with "Wheel" control require a visit to find out if Valve is fully open or partially so. Why waste time?
Waste Port which permits the air in Hose to escape to atmosphere when Valve is closed.
HOLLOW PLUG
AIR PASSAGE
Standard Pipe Thread

Style LW

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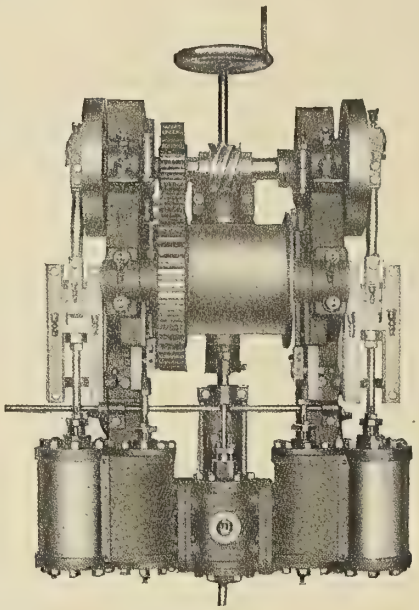
THE "MUNDY" ASH HOIST



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BULKHEAD, REQUIRING A MINIMUM OF SPACE.
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ENGINEERS AND MANUFACTURERS Established 1869 NEWARK, N. J.

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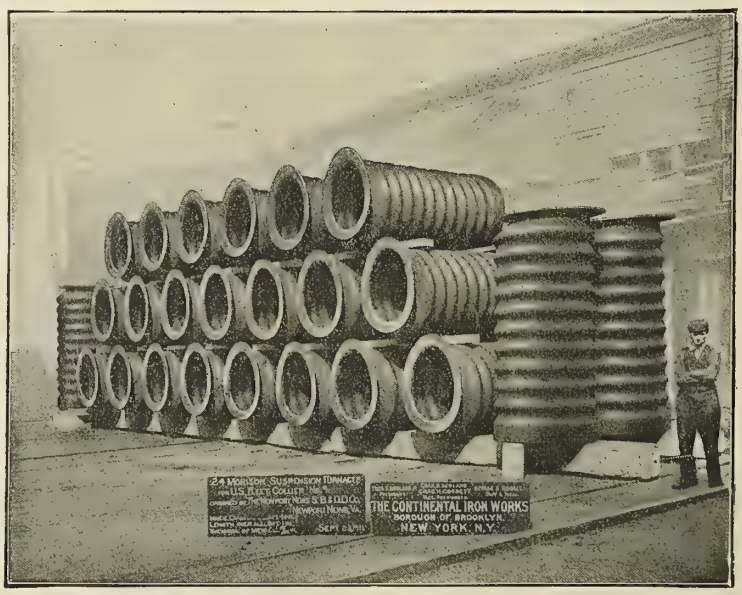
for

LAND and MARINE BOILERS



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EASILY CLEANED
UNEXCELLED STRENGTH

MADE TO UNITED STATES,
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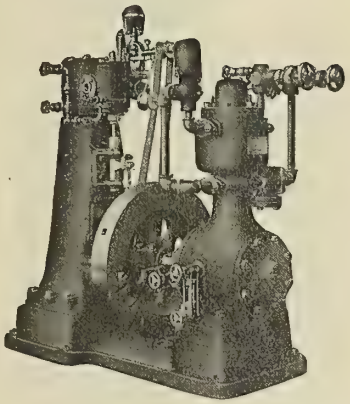
YORK MARINE REFRIGERATING MACHINERY



—is designed and built to meet the exacting conditions encountered on board ships—Reliability and Flexibility in operation, occupying a minimum deck space and headroom.

The special design and arrangement of the Compressor and Engine, or Motor, on the same bed plate enables both to be dissembled without additional deck space.

The Compressors—both Ammonia and CO_2—are built in various types and sizes, from ¼ ton refrigerating capacity upwards, and may be actuated by any available power.

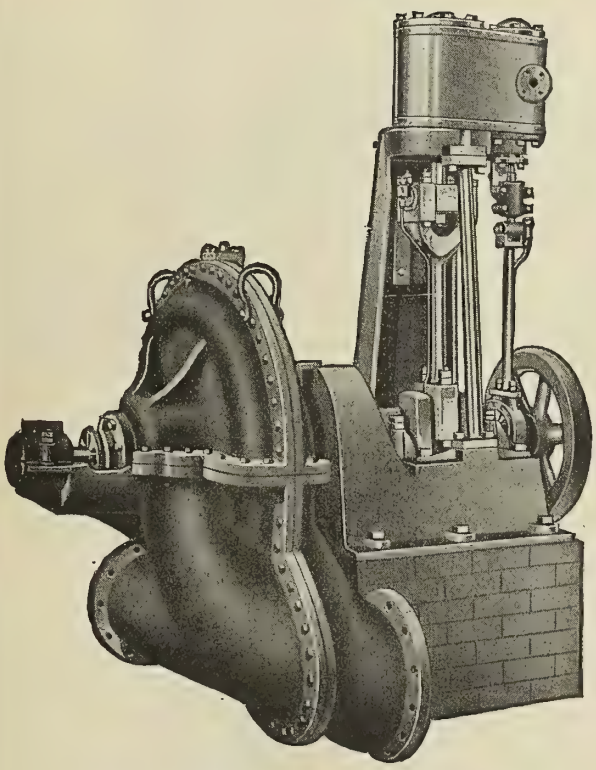
Condensers, Brine Coolers, Scuttle Butts and Ice Making Systems are likewise varied in type and design to suit the particular ship on which they are installed.

York Refrigerating Systems are scientifically designed and built by Specialists, who have devoted over 35 years to the development of this class of machinery exclusively.

Consultation on any Refrigerating Problem invited.

YORK MANUFACTURING COMPANY

YORK, PA.



Double Suction Pump directly connected to Steam Engine for Surface Condensers.

MORRIS is specializing on PUMPS for Surface Condensers.

A list of our customers would include the leading ship building companies of the United States and Canada.

Whether you require one or one hundred outfits we can take care of your requirements.

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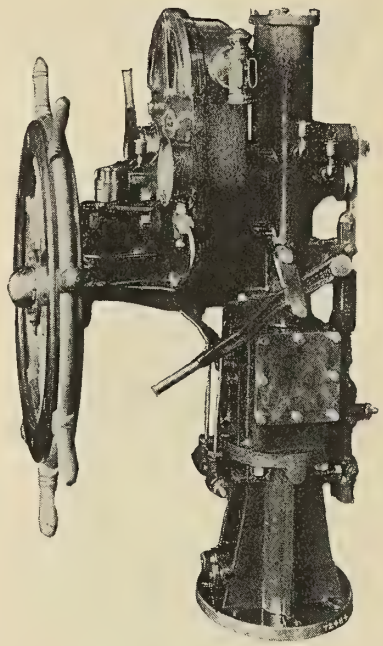

Quality demonstrated by years of service on vessels of all types.

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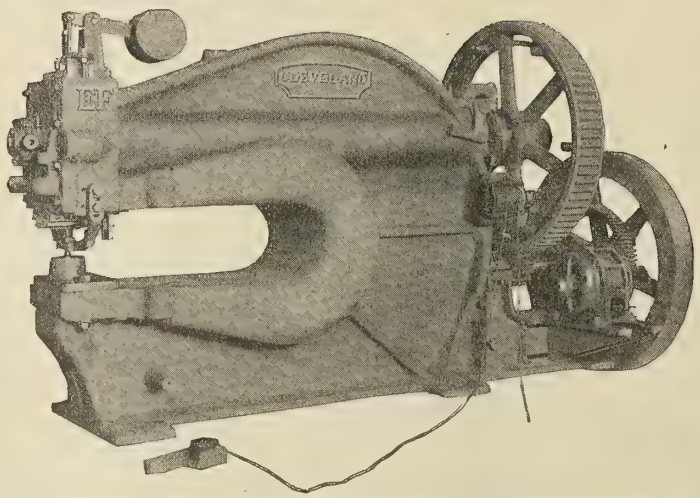
Sound judgment must be exercised in buying punches and shears. The machine itself represents only what is visible to the eye and what is represented or misrepresented by the seller.

In expensive massive machinery it often takes years to determine the true value.

The real criterion is the organization in back of the machine. Its record, its policies—all must be considered.

Investigate Clevelands.



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—WALL RADIAL DRILLS—BENDING AND STRAIGHTENING MACHINES

THE CLEVELAND PUNCH & SHEAR WORKS CO.

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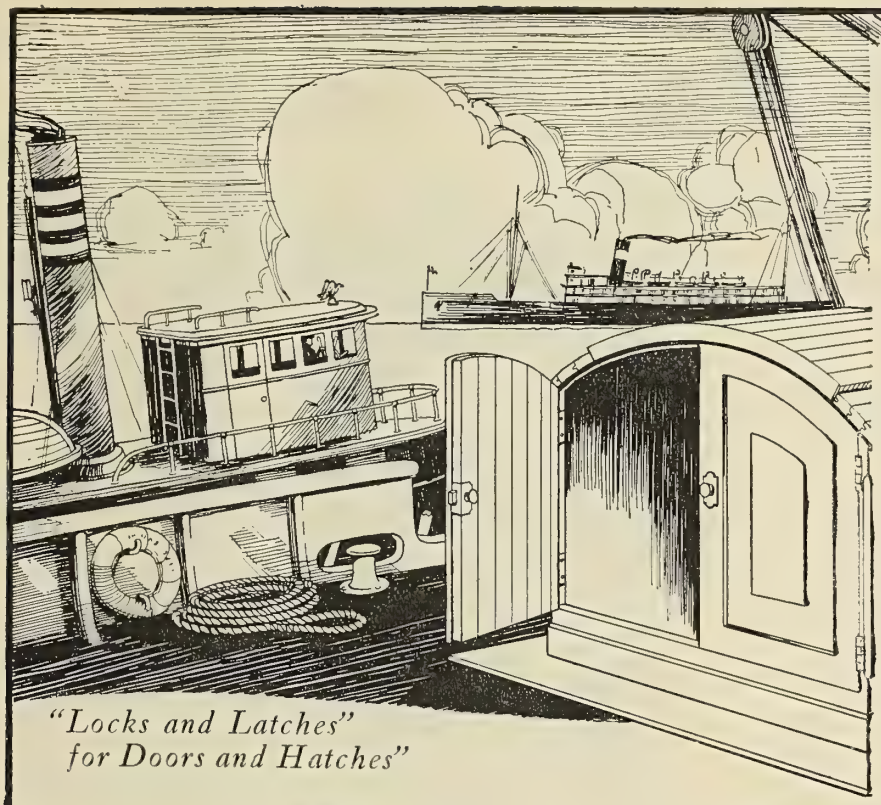


"Locks and Latches" for Doors and Hatches"

TIEBOUT
MARINE HARDWARE

Ever since 1853, Tiebout Hardware has been used by people who insist upon good quality. This standard of quality, rigidly held to, has established a reputation for Tiebout Marine Hardware that is second to none.

We carry in stock at all times a complete line

For Immediate Delivery

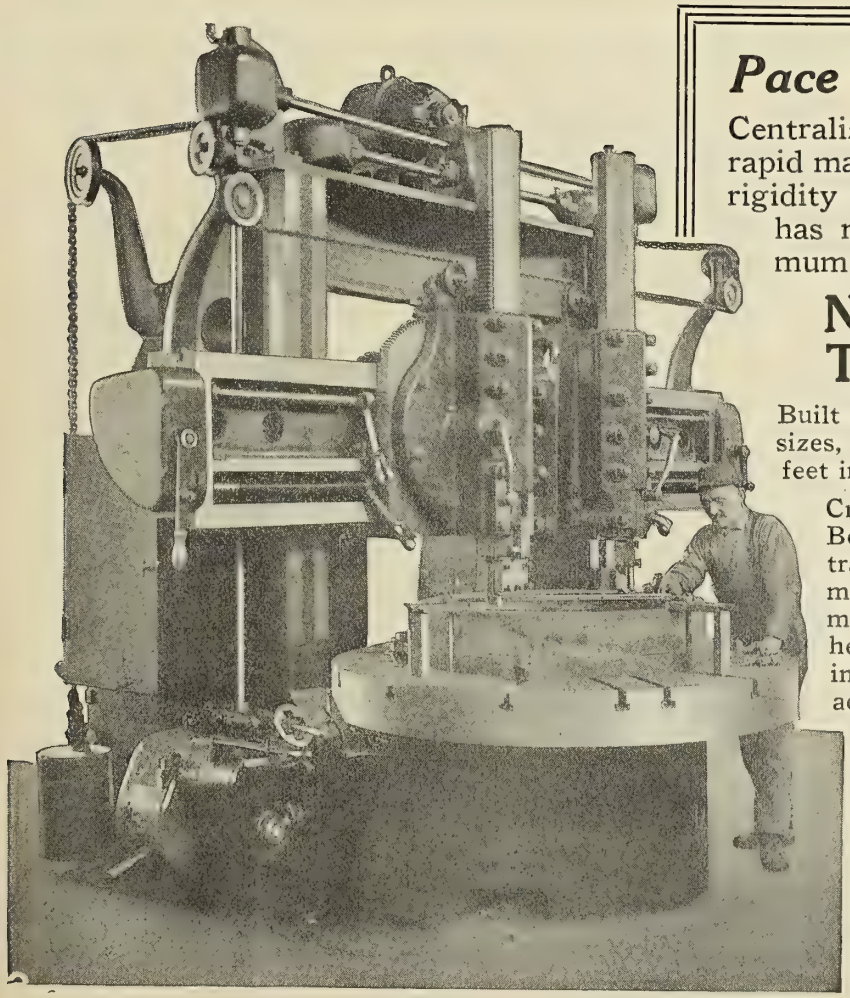
Tell us what you want, and you get it—quick. Tiebout clients are always satisfied with Tiebout Service.

A copy of our complete illustrated catalogue on your desk is a big buying help. Where shall we send it?

W. & J. TIEBOUT

Established 1853
118 Chambers Street

Incorporated 1892
New York City



Pace Makers for the Shop

Centralized control which permits easy, rapid manipulation, and with strength and rigidity to stand up to fast, hard cutting has made it possible to attain maximum production with

N-B-P BORING and TURNING MILLS

Built as illustrated in 44, 53, 62 and 73 inch sizes, and in other heavier types up to 42 feet in diameter.

Cross rail is raised and lowered by power. Both bars and saddles have power rapid traverse, variable and reversible automatic feeds and hand fine adjustment. All movements are independent for each head. The wide use of these machines in shops of all kinds emphasizes their acceptance as a standard of quality.

We'll be glad to send catalogues and prices.

NILES - BEMENT - POND CO.
General Offices 111 BROADWAY, NEW YORK
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CORRUGATED BOILER FURNACES

All sizes, plain or flanged ends for

LAND and MARINE BOILERS

Made in accordance with
UNITED STATES STEAMBOAT
INSPECTION, AMERICAN BUREAU
and LLOYD'S REGISTER OF SHIPPING
BUREAU OF VERITAS
or other specifications

Seamless Forged Steel Boiler Nozzles
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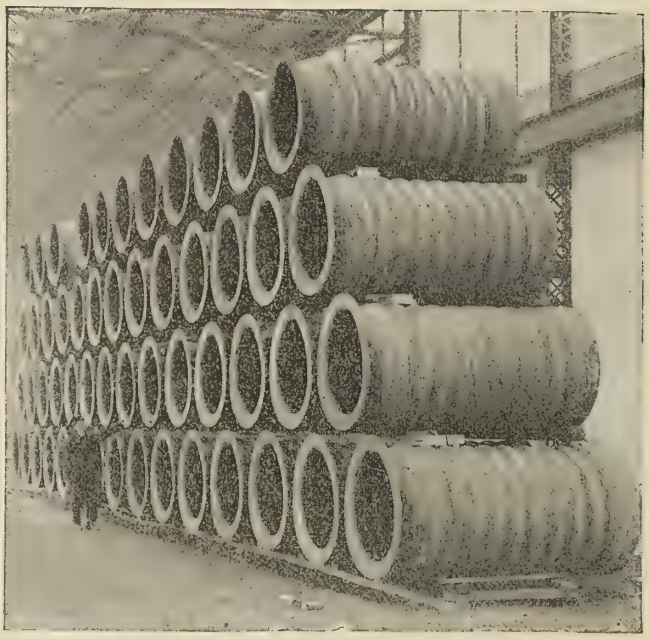
Forged Steel Pipe Flanges
in stock for prompt shipment

Lap Welded Steel Pipe
Sizes 12 to 72 inches

Manufactured by



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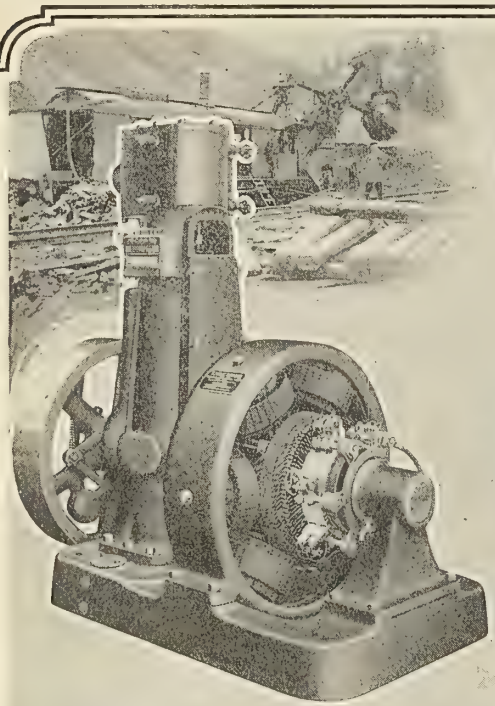
NEW YORK CITY OFFICE, 50 CHURCH ST.



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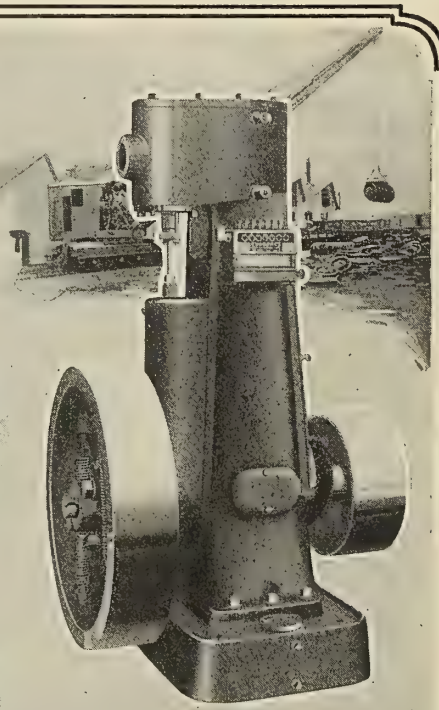
1 TO 50 K. W.
Described in Catalog 103

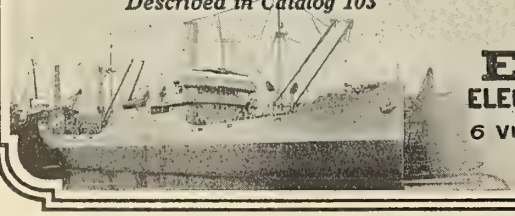
Engberg
THE STANDARD FOR EFFICIENCY-DURABILITY-SERVICE

Engberg Generating Sets are most economical and dependable, making them especially satisfactory for all kinds of service where continuous and satisfactory operation is desired.

Engberg Engines are desirable for all power purposes. They combine every distinctive, discriminating and serviceable feature essential for proper performance.



VERTICAL ENGINES
1 TO 100 H. P.
Described in Catalog 301



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ELECTRIC & MECHANICAL WORKS
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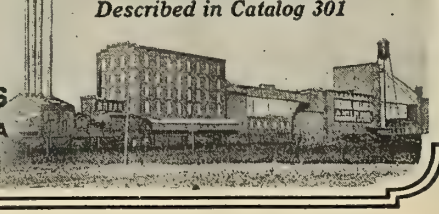

"WAINWRIGHT" Marine Feed Water Heaters

Corrugated Tubes
Separate Water Channel
Plain Covers

Straight Tubes
Easy Cleaning
Convenient Inspection

Cast Iron Shell will not rust out.

Ask for Bulletin.

ALBERGER PUMP AND CONDENSER COMPANY

140 CEDAR STREET, NEW YORK, N. Y.

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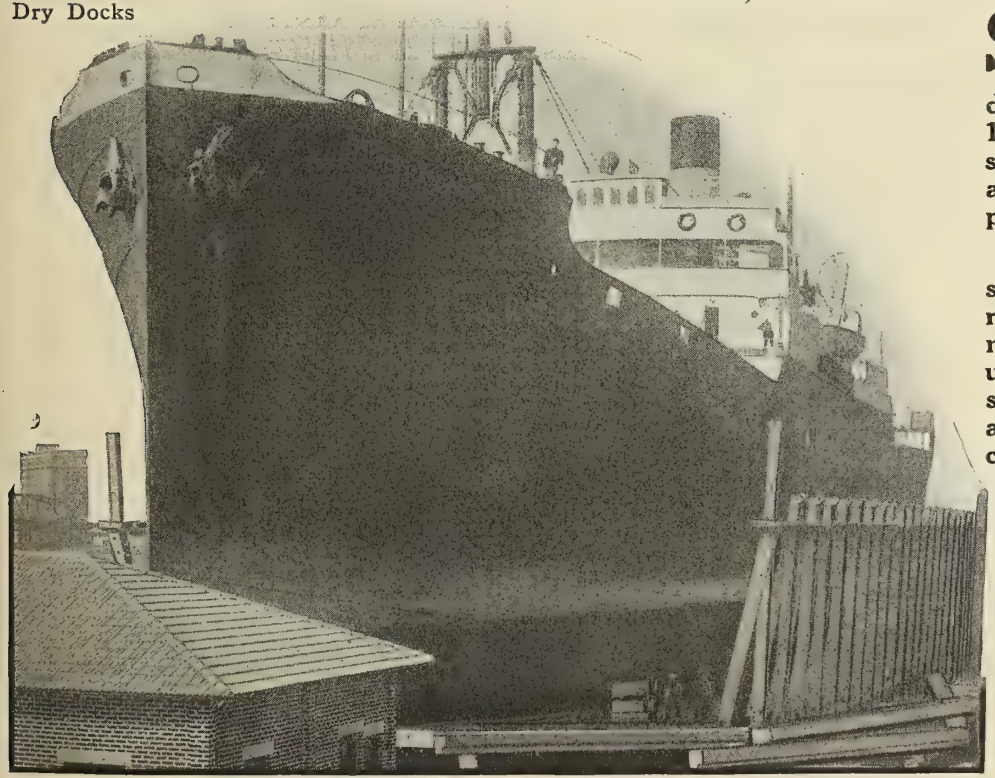
THE CRANDALL ENGINEERING CO.

CONTRACTING **ENGINEERS** CONSULTING

BOSTON, MASS.

Designers of Dry Docks



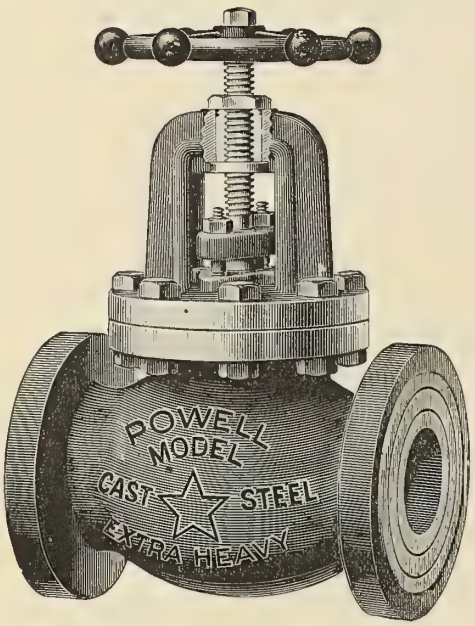
SINCE 1854 we have been specializing in designing dry docks. Today more than 140 dry docks of our design are in operation—ample proof of our experience.

Our experience, our specially trained engineers, our construction methods comprise a unique service which assures economy in design and construction and certainty in results.

5000 Ton Railway Dry Dock

Colonna Marine Railway Corp., Norfolk, Va.

POWELL VALVES



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MADE OF THE HIGHEST GRADE OF

Cast Steel

Some of the largest shipbuilding companies in the United States are specifying

Powell Cast Steel Valves

They are absolutely dependable in every particular, being entirely free from porous defects. All valves are given a thorough tensile strength and hydrostatic pressure test before shipments are made.

Specify POWELL CAST STEEL VALVES

THE WM. POWELL CO.

DEPENDABLE ENGINEERING SPECIALTIES

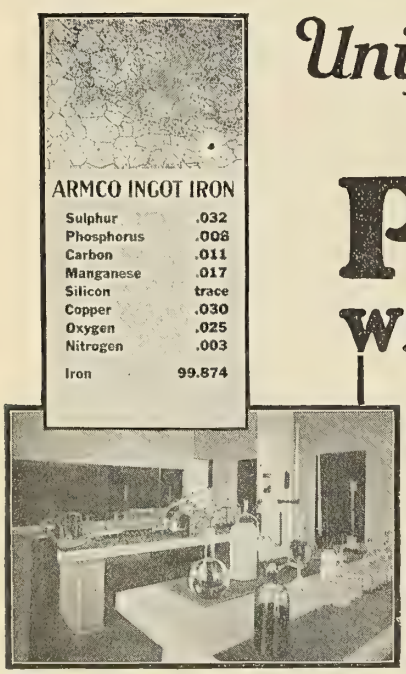
CINCINNATI, OHIO

1276-1279

Uniformity of Analysis Under Control
in the manufacture of

PAGE-ARMCO

WELDING RODS *and* ELECTRODES



The usual analysis of iron and steel does not carry beyond the big five, namely:

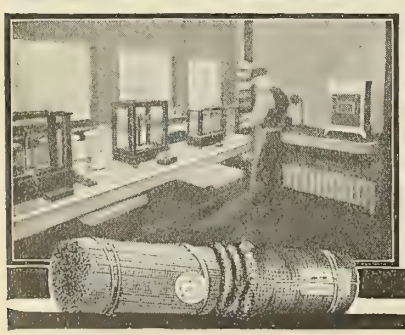
Carbon Manganese Phosphorus Sulphur Silicon

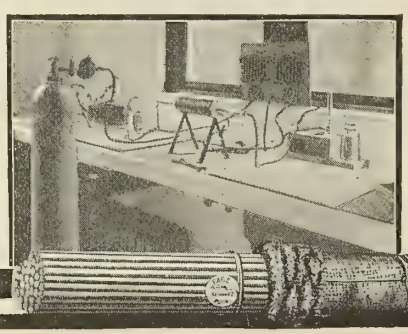
PAGE-ARMCO Ingot Iron as shown is analyzed for nine elements including the gases and is the purest commercial iron in the world guaranteeing a sound weld of the highest ductility.

PAGE-ARMCO Welding-Rods and Electrodes fulfill all the requirements of the American Welding Society's Specifications.

Carried in stock by distributors in all industrial centers.

ARMCO INGOT IRON



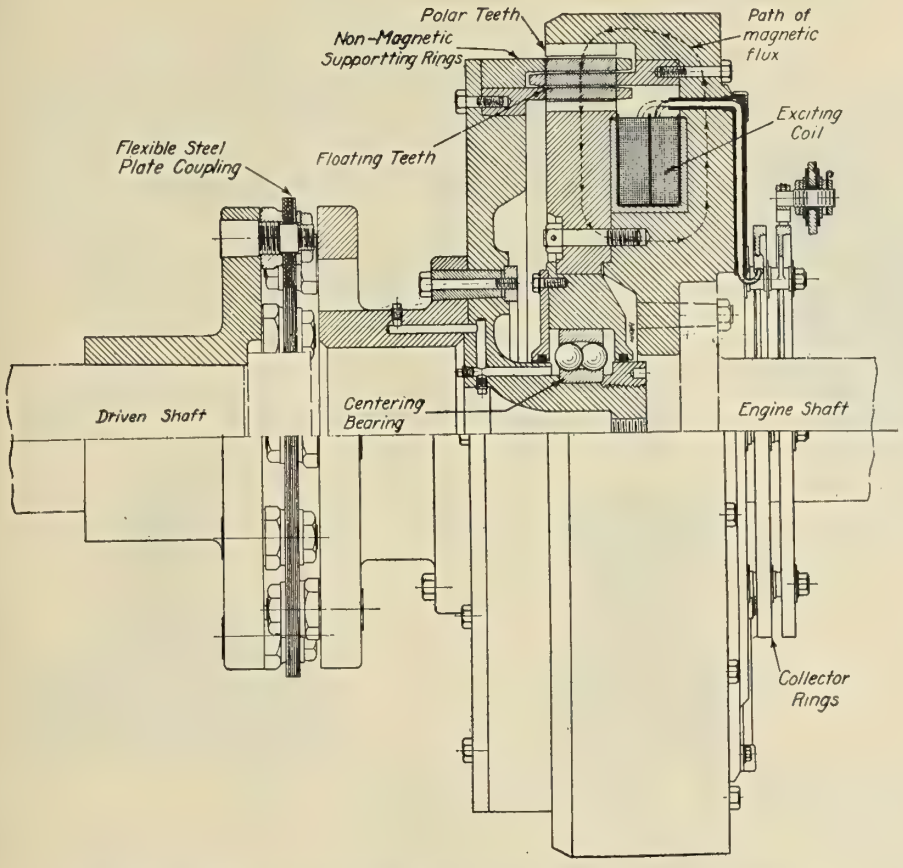


PAGE STEEL & WIRE CO.

MANUFACTURERS OF

Rods—Ingot Iron and Special Analysis Steels
Wire—Plain and Galvanized—Spring, Rope, Telephone, Telegraph
Fence—Woven—Right-of-Way and Farm-Chain Link, Factory Partitions, Gates

GENERAL SALES OFFICE: Grand Central Terminal, New York City
DISTRICT SALES OFFICES: Chicago, Pittsburgh, San Francisco, Portland, Ore.



Flywheel Type Clutch Coupling as used with 700 H. P. Diesel Engine.

THE SPERRY
Magnetic Clutch Coupling

The first *true* Magnetic Clutch Coupling for *commercial purposes.*

Has the *velvet touch* of the perfect *air* drive.

Is *self-aligning* and *perfectly flexible* both *axially* and *radially.*

Gives *perfect* control without *jar, strain* or *shock.*

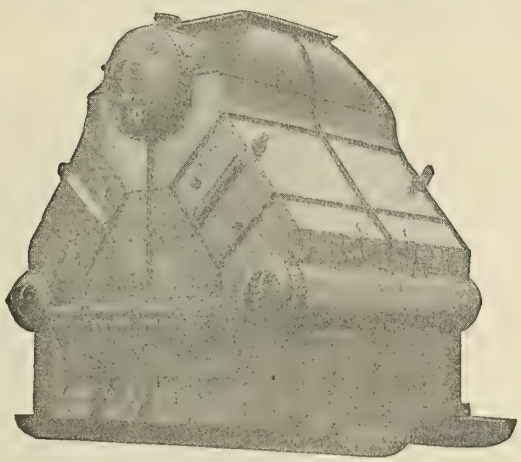
Write for particulars.

THE SPERRY GYROSCOPE CO.
MANHATTAN BRIDGE PLAZA
BROOKLYN, N.Y.

New York Engineering Company
LUDLUM WATER TUBE MARINE BOILER
The New Marine Standard

A Self Contained Unit. Shipped Fully Erected.

All Wrought Steel.

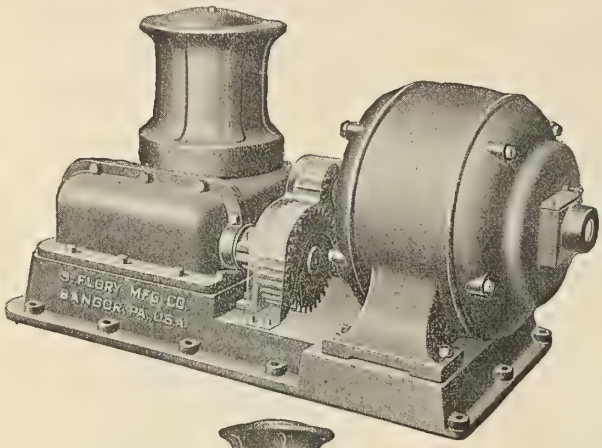


No Stray Bolted Surfaces. A Superior Oil Burner. Unequaled Compactness.

On Skids, Ready for Shipment as a Unit

Quick deliveries assured from ample stock of material on hand.
Write for the Catalogue.

NEW YORK ENGINEERING COMPANY
2 Rector Street, New York **Works—Yonkers, N. Y.**



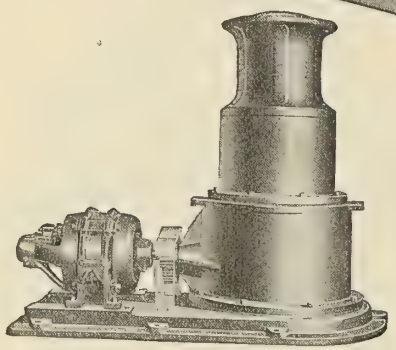
Flory Capstans

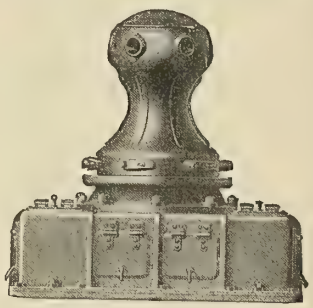
Any Type Any Size

Steam—Electric—Hand

For Battleships or Barges

Special Machines Designed to Meet Requirements



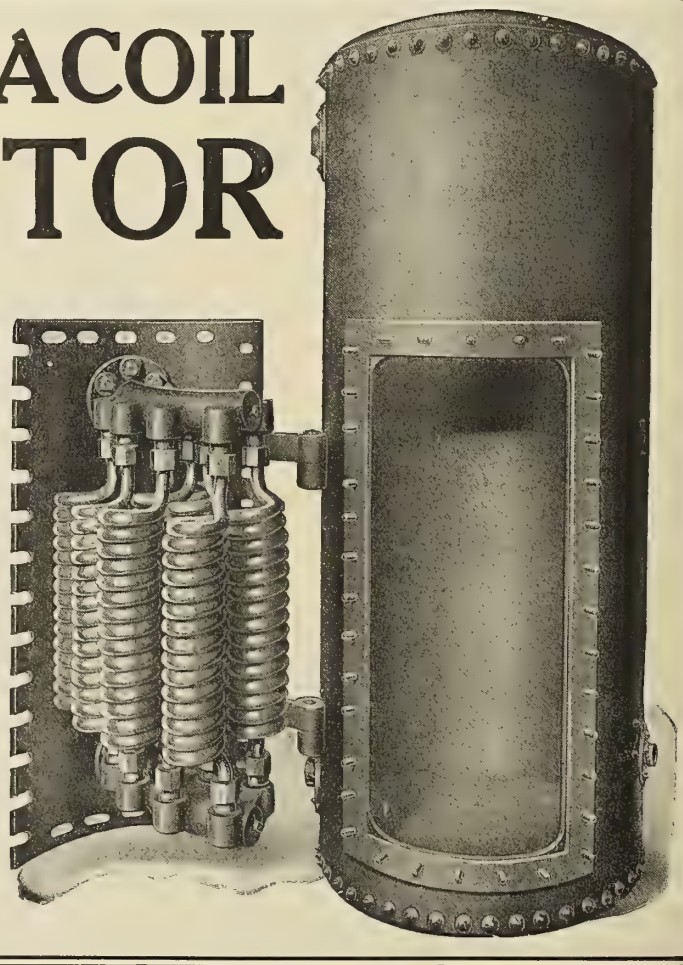


S. FLORY MFG. CO., Bangor, Pa.

Marine Dept., New York, 95 Liberty St.

Winches — Capstans — Windlasses — Hoists — Cableways

The R&D PARACOIL EVAPORATOR



R & D Paracoil Evaporators and Distilling Condensers are made for both single and multiple-effect plants in marine service.

Constructed with cast iron or steel plate shells, of all capacities up to 50 tons per 24 hours per unit.

Improved cleaning facilities make maintenance expense low.

Row & Davis Engineers, Inc.

Consulting and Contracting Engineers

Feed Water Heaters, Feed Water Filters, Grease Extractors, Distillers, Ash Ejectors, Condensers, Fresh Water Stills, Fuel Oil Heaters, Oil Coolers, R & D Gravity Flow Filters and Inspection Tanks, RanD System for Bunker Oil.

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WARREN

Are not orders for additional equipment the natural result of the confidence placed in Warren Marine Pumps by a host of satisfied users?

The first issues of a series of new bulletins are now ready for distribution and will be mailed upon request.

WARREN STEAM PUMP CO.

BOSTON
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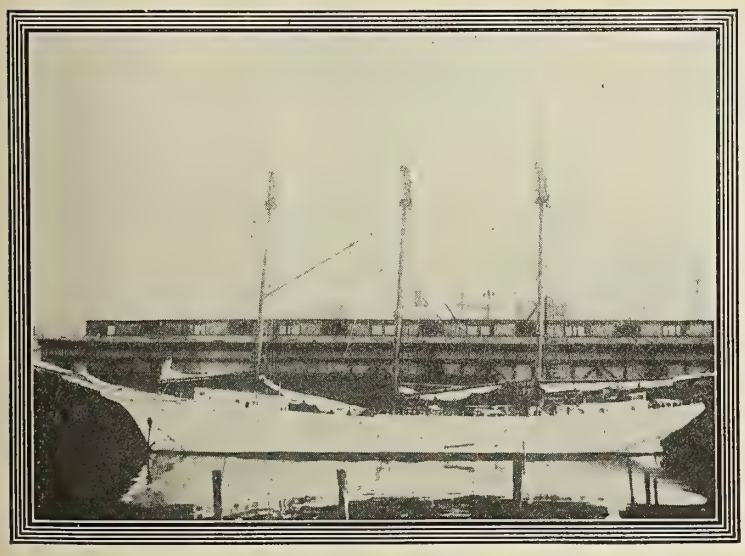
Main Office and Works:
WARREN, MASS.

Fairbanks-Morse "C-O" Marine Oil Engines



The Schooner "Samuel Courtney"

From New Foundland to Piraeus, Greece, in 23 Days

That's a record established by the "Samuel Courtney" soon after her "C-O" power plant was installed. Her master is enthusiastic in his praise of the "C-O" engines for their economy and dependability.

The "Samuel Courtney" is 167 ft. long; keel, 138 ft.; beam, 35 ft.; draft, 14 ft.; net tonnage, 441. Two 100 H.P. "C-O" engines drive it at 7 knots per hour loaded.

"C-O" marine engines economically use low priced fuel oils. They are easy to start—simple to operate. Ask for full information about this proven work-boat power.

FAIRBANKS-MORSE QUALITY F M 100%

Fairbanks, Morse & Co.
MANUFACTURERS CHICAGO

Oil Engines - Pumps - Electric Motors and Generators - Fairbanks Scales - Railway Appliances - Farm Power Machinery

SUPERINTENDING ENGINEERS

WHEN YOUR VESSELS ARRIVE IN PORT ARE FIRESIDES OF BOILERS CLEAN AND FREE FROM SOOT? IF NOT YOU ARE WASTING FUEL.

DO YOU EMPLOY SHORE LABOR TO PULL RETARDERS, SWEEP TUBES AND CLEAN COMBUSTION CHAMBERS? IF SO IT IS UNNECESSARY EXPENSE.

We have authentic records of a 10,000 ton ship equipped with Scotch boilers, Howden forced draft, tube retarders and Bennett Flue Blowers having made 67 voyages on the Great Lakes without cleaning firesides of boilers except by use of the Bennett Blowers, and the records show that that ship continued to make maximum speed with minimum fuel consumption.

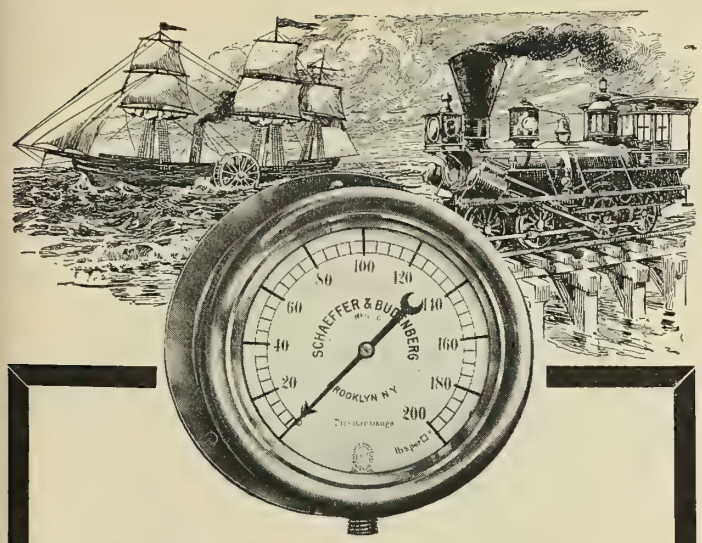
Bennett Blowers are in satisfactory use on hundreds of vessels of leading steamship companies.

Installed on 30 days' trial free of cost to owners.

BENNETT FLUE BLOWER COMPANY, Inc.

Main Offices: 2 Rector Street, New York

Telephone: Rector 2318



Standard Then— and Standard NOW

Back in the old days before the Civil War, when sails were still considered a necessary adjunct to steam craft, and before locomotive builders had learned that they could lift the boiler above the wheels, engineers had learned to associate the word "Standard" with

S&B Gauges

For Every Requirement

Somewhat crude in outward appearance were those original gauges, built by us over sixty years ago, but so fine was their workmanship and so accurate their readings that they quickly won the respect of the engineering world.

Today an engineer will nod his head in approval when you mention S & B Gauges. To him they mean the standard by which all other gauges are judged.

There is an S & B Gauge for every requirement—steam, vacuum, water, gas, air, ammonia, etc.—each substantially constructed to withstand long service. Consistent with their internal perfection, all S & B Gauges are made with non-glare dials, for easy and accurate reading.

Write Today for Catalog A-23, giving full particulars.

THE Schaeffer & Budenberg MFG. CO.

Makers of Columbia Recording Thermometers and Gauges with Time Punch, etc.

BROOKLYN, N. Y.

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"She's Just in From Singapore"

—last time she made New York was ten years ago, and then we chipped all the rust and scale out of her double bottom. Gave her a general clean-up and coated her inside with Briggs Bituminous Composition. Since then she's been carrying every kind of cargo there is—yet when I went through her this morning, there wasn't a speck of rust."

—"Bituminous Bill"

Briggs Bituminous Composition

Gives lasting protection against rust and corrosion to ships' inner plating, tank tops, bunkers, engine and boiler settings, and all the out-of-the-way spots that would otherwise require constant attention.

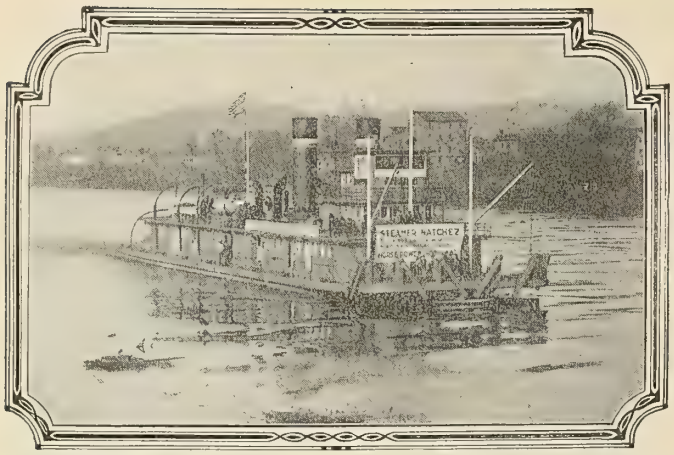
It forms a firm, elastic, wear-resisting film which is not affected by acids, alkali, moisture, heat or cold. It will not crack, chip or flake off—one coating will last for years. For thorough protection, specify Briggs.

Write for our booklet, "The solution of the Corrosion Problem."

Briggs Bituminous Composition Co.,
Incorporated
17 Battery Place New York, N. Y.

BBC-29

BRIGGS BITUMINOUS COATINGS
The Solution of the Corrosion Problem



Columbian Bronze Propellers

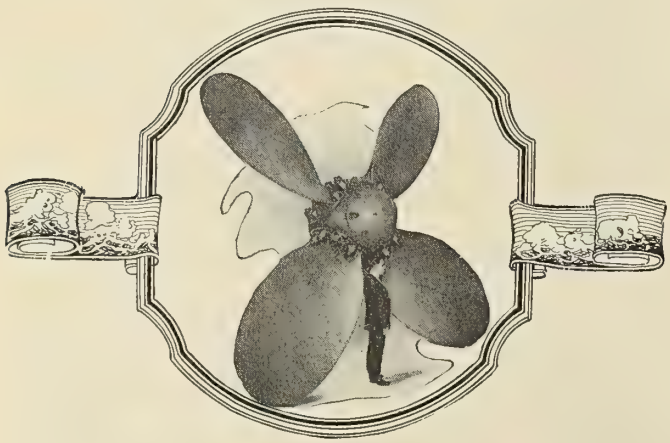
NATCHEZ—a Mississippi Warrior Service boat—is equipt with a pair of four blade 9′ 3″ diameter Columbian Bronze Propellers.

Five sister ships of the "Natchez" are likewise equipt with Columbian Bronze Propellers.

Mississippi Warrior Service subjects propellers to the hardest kind of service, as these boats maintain the channel clear of obstructions, keep the banks in repair, etc.

The War Department purchased Columbian Bronze Propellers for these boats because Bronze Propellers are more efficient and considerably more economical in the long run.

COLUMBIAN BRONZE CORPORATION
522 Fifth Avenue New York City



"CONSOLIDATED"
Commercial Craft

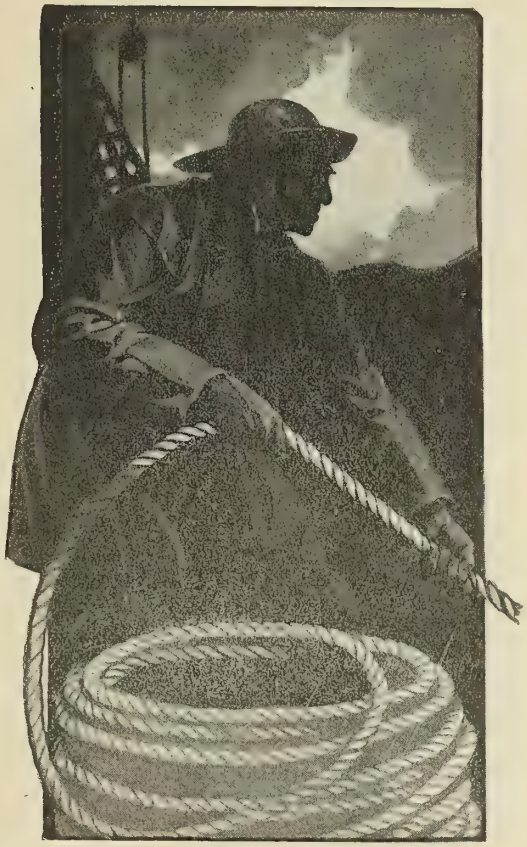
THE genuine economy of having a commercial craft built throughout of the finest materials and the finest workmanship is without question.

Through our long experience in building the highest types of *pleasure* craft and their engines, we are especially well equipped to assure the speed and economical construction of steel and wooden vessels up to 300 ft. in length, including their propelling machinery.

We shall be pleased to estimate on the construction of harbor and seagoing tugs, oil tankers, fruit steamers, lighters, trawlers, cargo carriers and passenger boats of any type.

Write us for full information, and printed matter showing examples of our work.

CONSOLIDATED
SHIPBUILDING CORPORATION
MORRIS HEIGHTS, NEW YORK CITY



"AMERICAN" BRAND MANILA ROPE

"THE RELIABLE ROPE"

is preferred by marine men, because it is consistently good.

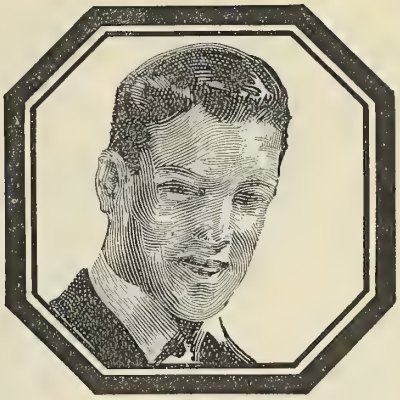
It gives—

"MORE VALUE IN EVERY WAY"

We also make—

"American" No. 1 Best Marine Oakum
"That Caulking good Oakum."

AMERICAN MANUFACTURING CO.
Noble and West Streets, Brooklyn, N. Y.
Western Branch:
St. Louis Cordage Mills, St. Louis, Mo.



Add this Man's Brains to Your Own

Successful men in all lines use the brains of others. This is equally true of the engineering profession. You as an engineer will be more successful—more valuable to your employer—if you profit by the ideas and inventions of specialists.

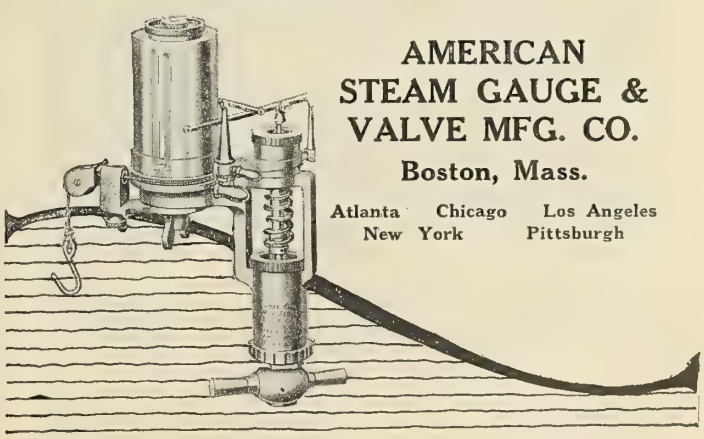
One way to do this is to make a practice of constantly using the

AMERICAN THOMPSON IMPROVED INDICATOR

This indicator—the only flawless instrument of its kind made—is the *original* indicator invented by the late J. W. Thompson, an engineer of international fame, and perfected by him after years of tireless experiment. His ability and brains become *your* ability and brains when you employ the American Thompson Indicator in your profession.

By means of the American Indicator you can know many things about your engine that you have never been able to know before with absolute accuracy. It enables you to conserve power, save fuel, rectify installation errors and prolong the life of your engine. In a word, it makes you an engineering expert of the highest order. And that means a fatter pay envelope.

A Postcard brings our valuable Free Booklet.



AMERICAN STEAM GAUGE & VALVE MFG. CO.
Boston, Mass.
Atlanta Chicago Los Angeles
New York Pittsburgh

BOLTS EMPIRE NUTS-RIVETS

YOU may have perfect assurance of quality in the separate parts of a ship you are building, but if you lack equal assurance in the matter of the bolts and nuts that hold the assembled units together, you cut heavily into your margin of safety.

Every Empire Bolt and Nut is guaranteed. Strength and close gauging of threads, accurately ground surfaces to insure flush fitting, the choicest soft open hearth steel, inspection that checks and counterchecks—these are the factors that give security.

And then, back of it all, are 75 years of fruitful experience in serving the great industries of the world.

It is SAFER to deal with such a house.

RUSSELL, BURDSALL & WARD BOLT & NUT COMPANY

PORT CHESTER, N.Y.

PEMBERWICK, CONN. CHICAGO · SAN FRANCISCO ROCK FALLS, ILL.

Makers of Bolts, Nuts and Rivets Since 1845

BUFFALO OIL BURNING RIVET FORGE

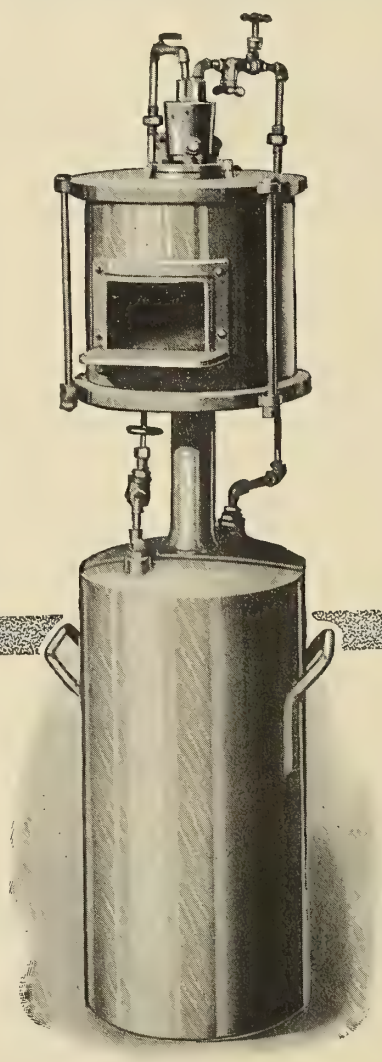
Wherever there are rivets to be heated these forges can save money for you.

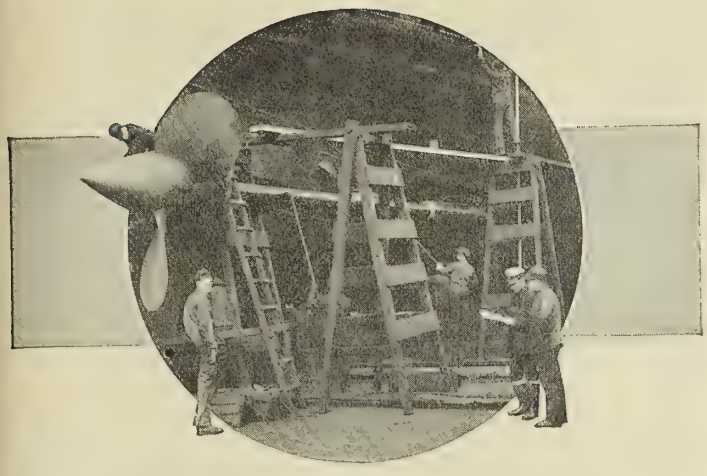
They are light, strong and portable. While economical in first cost and operation, they are built to last under severe service.

The compressed air insures a clean steady heat, which of course, means quick, uniform heating of rivets, with minimum attention. Ask any user of Buffalo Oil Burning Forges or write Dept. 63 for literature.

Buffalo Forge Co.

Buffalo, N. Y.





Federal Marine Paints Reduce Drydocking Costs

Paint once—and paint well—with Federal Marine Paints, instead of painting often with low-priced but inferior paints and high-cost labor. The over-all saving will absorb, several times over, the slight additional cost of Federal Paints.

The extreme smoothness of body, firm adherence and tough, wear-resisting qualities found in Federal will assure long, satisfactory service. Federal Paints and Compositions are to be had in a full range of colors, for all classes of vessels and for every marine purpose. You can have any quantity for quick delivery anywhere, from our branch offices in the principal ports of the world.

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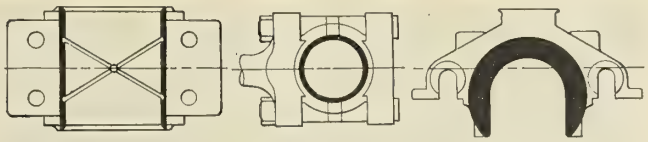

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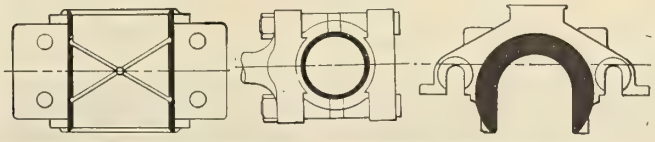

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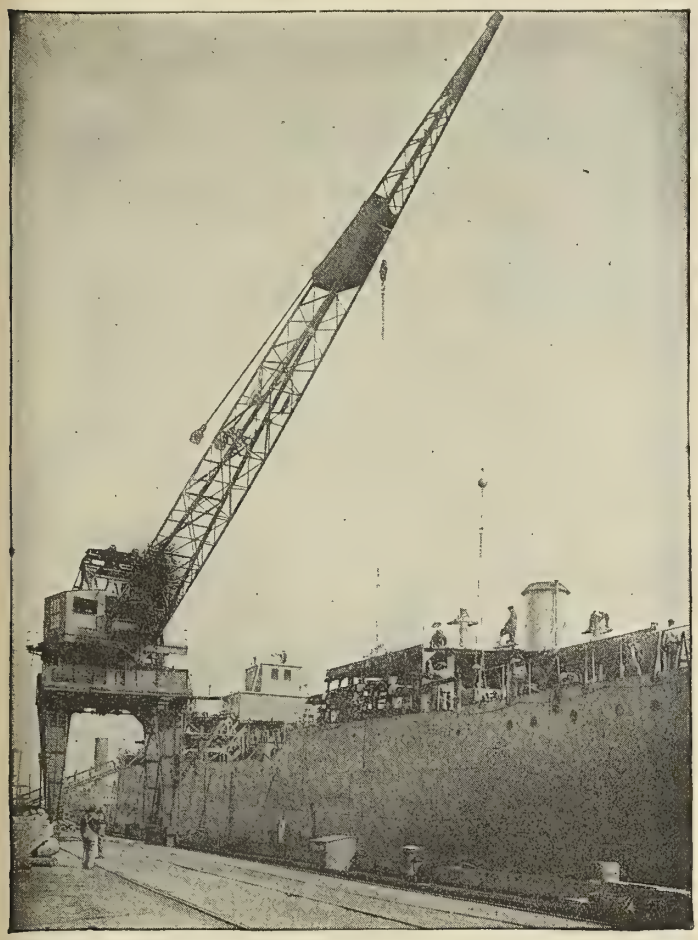

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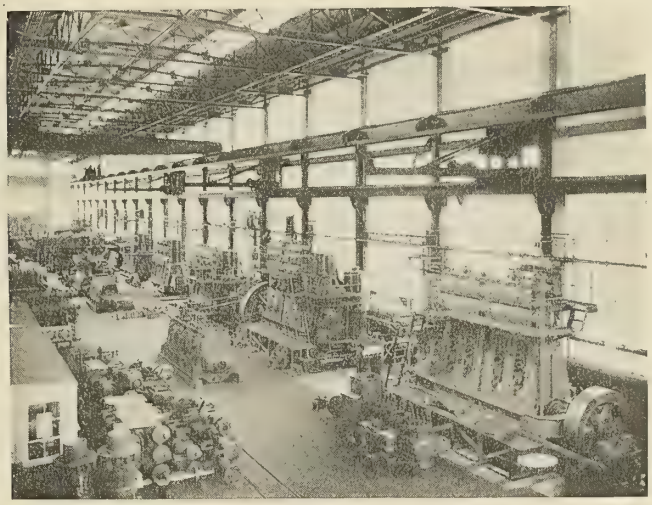

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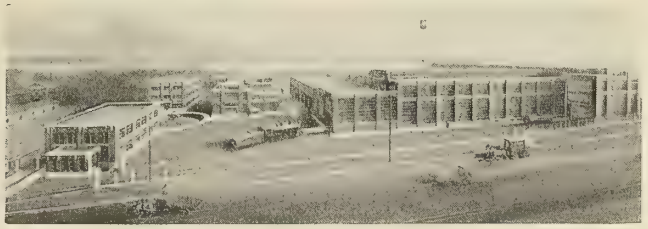

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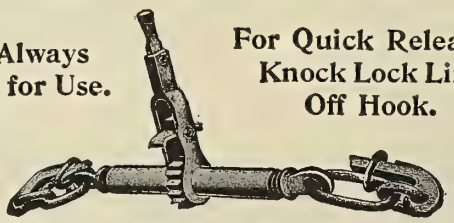

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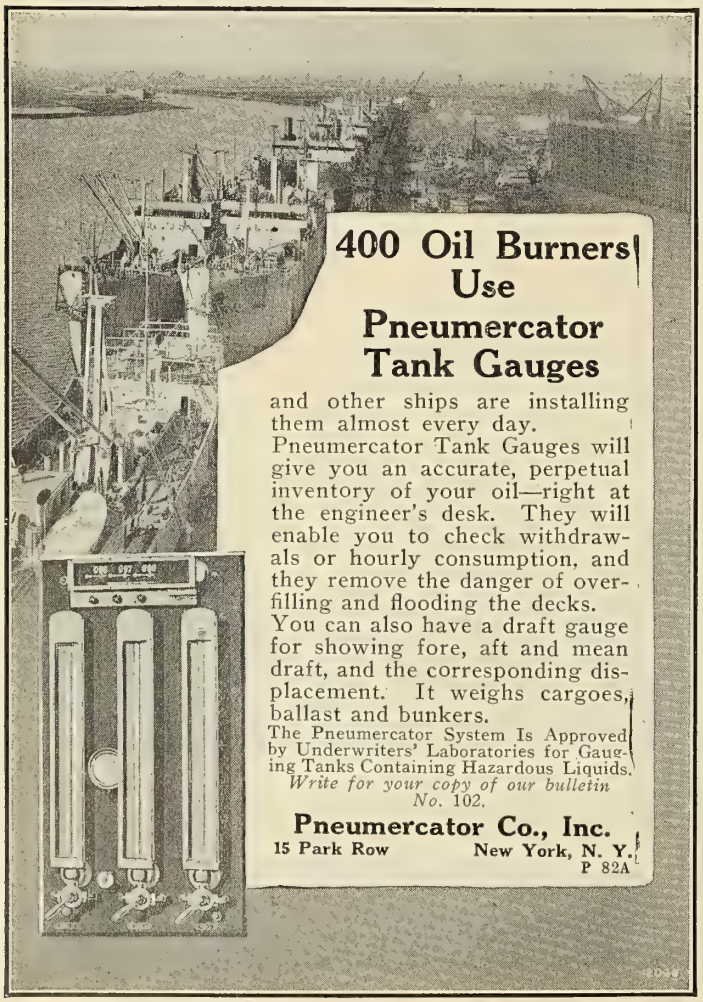

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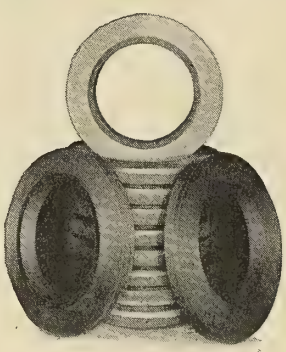

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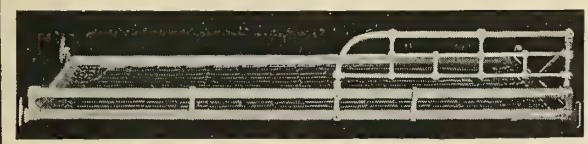

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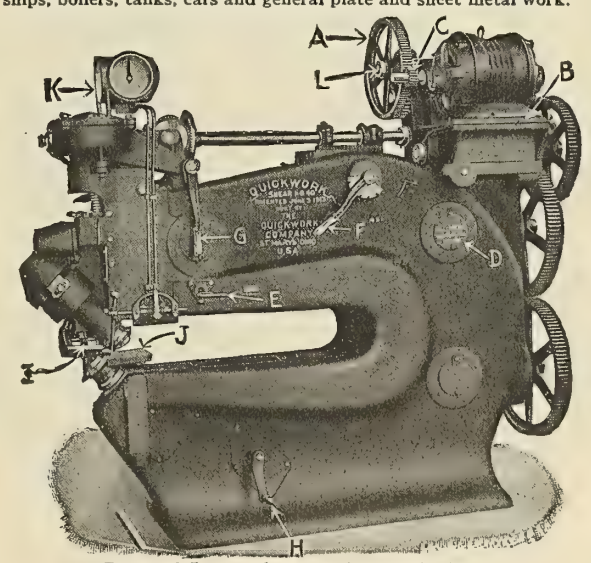

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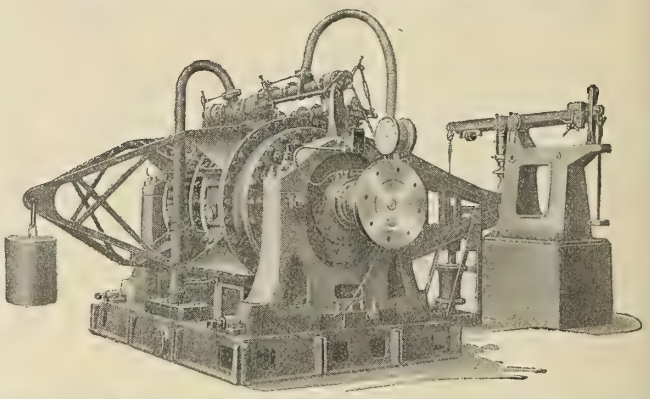

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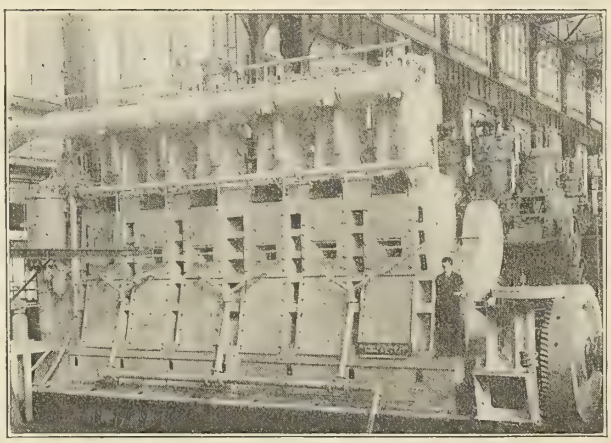

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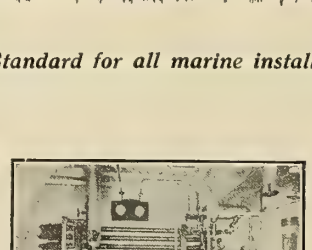

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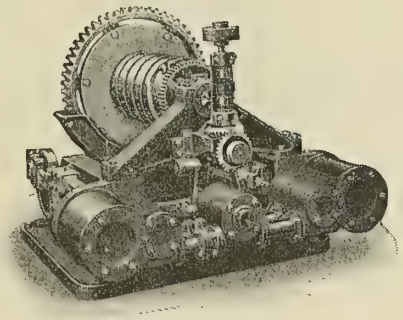

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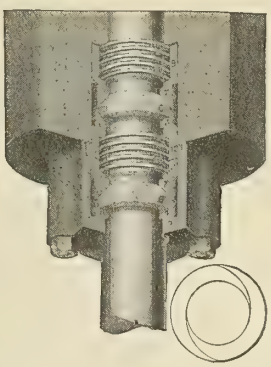

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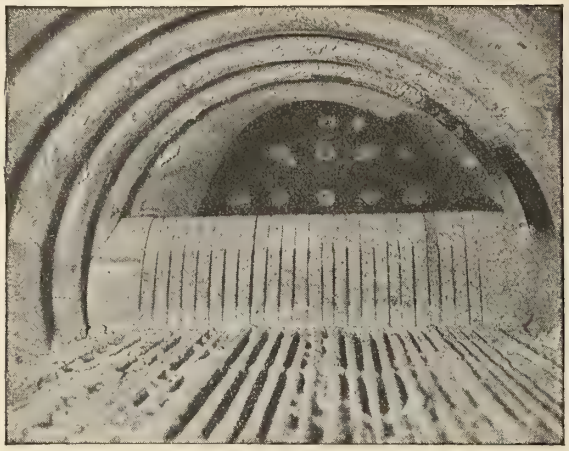

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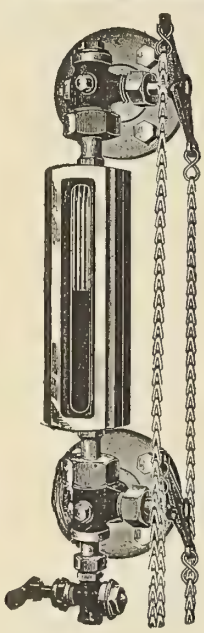

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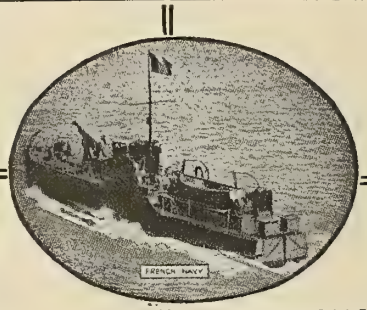

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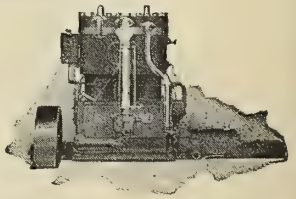

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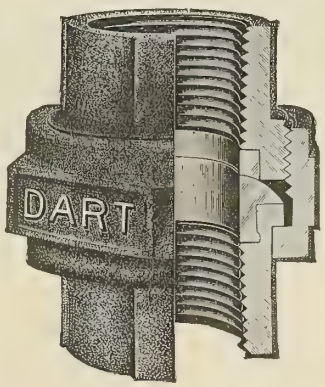

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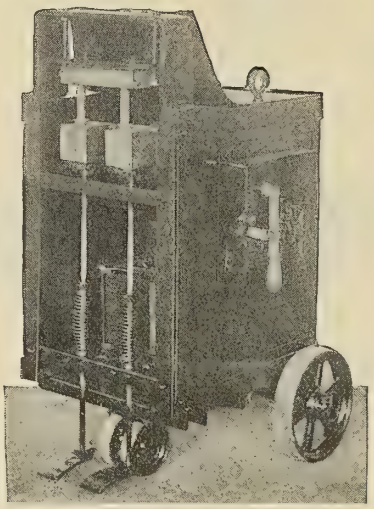

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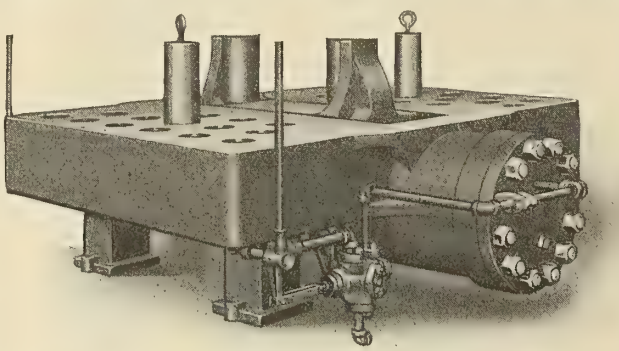

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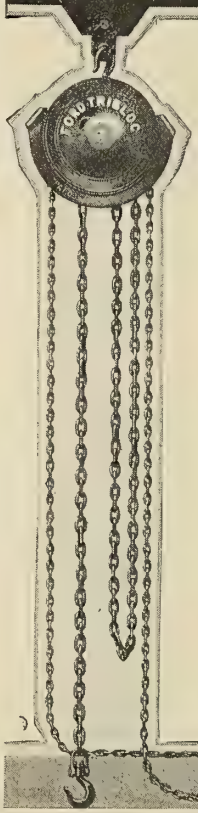

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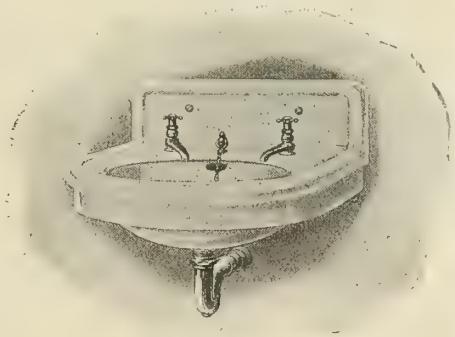

Plate S-208

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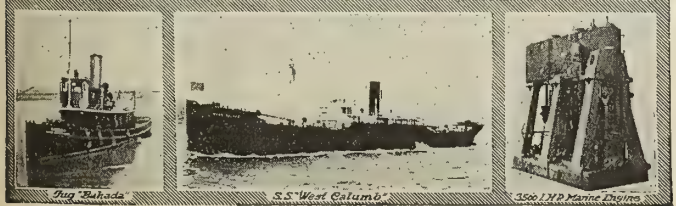

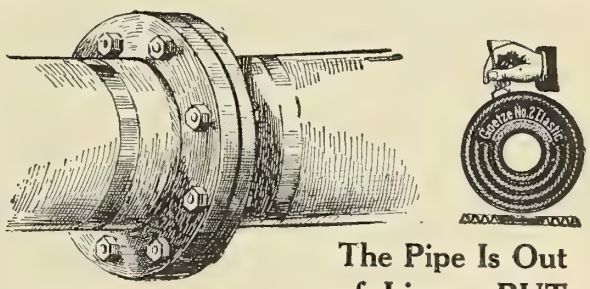

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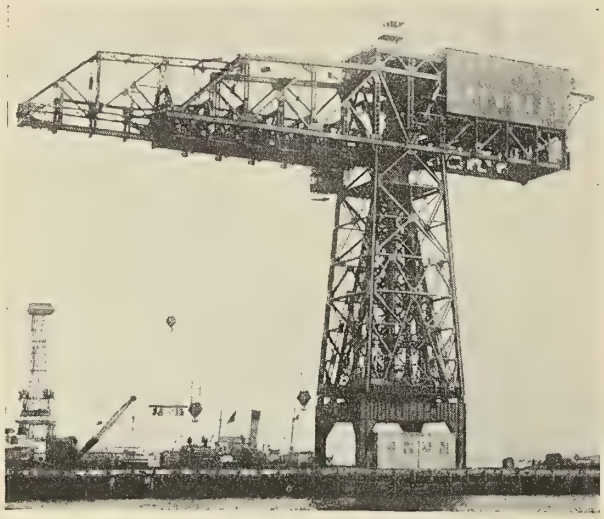

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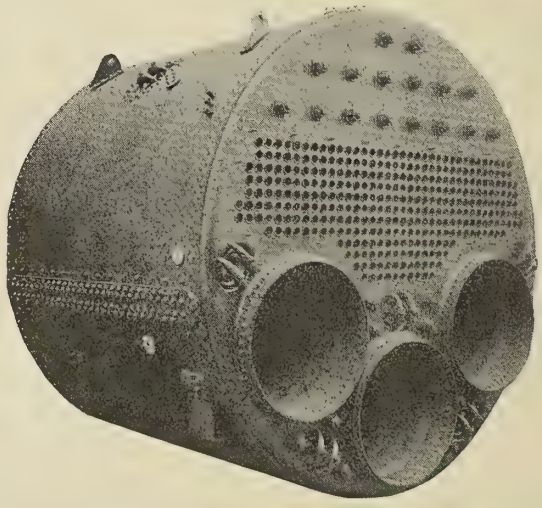

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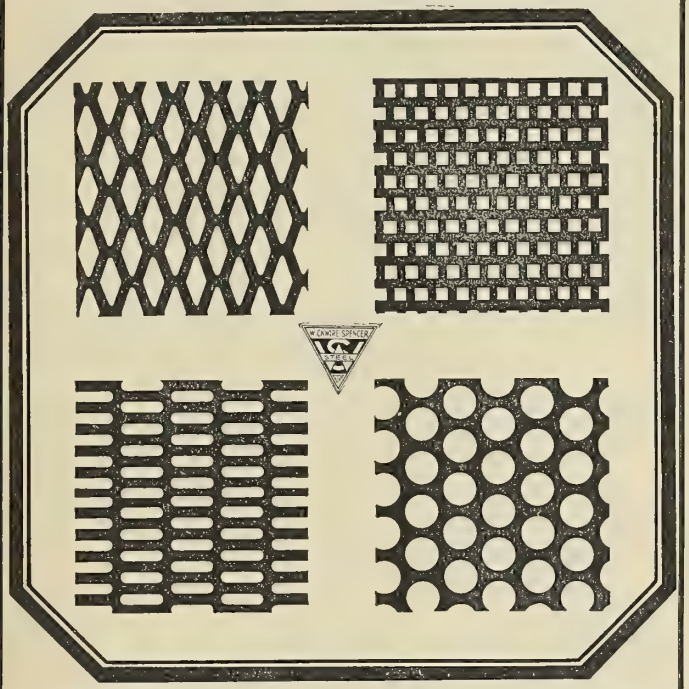

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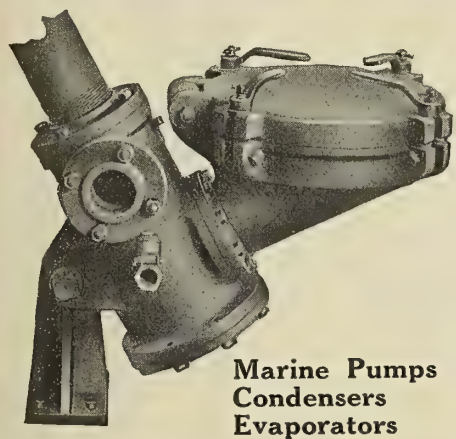

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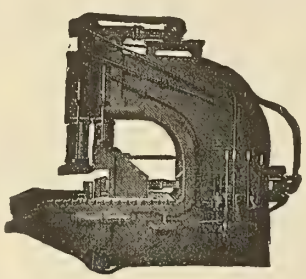

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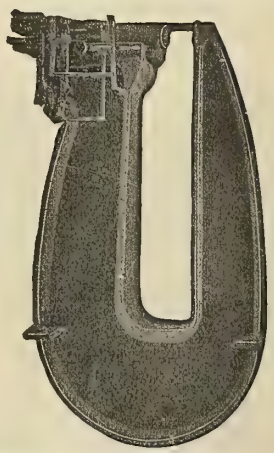

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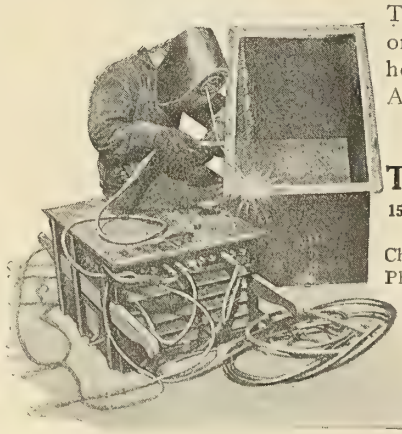

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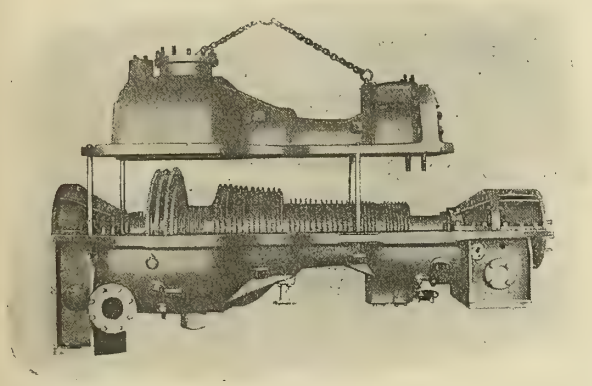

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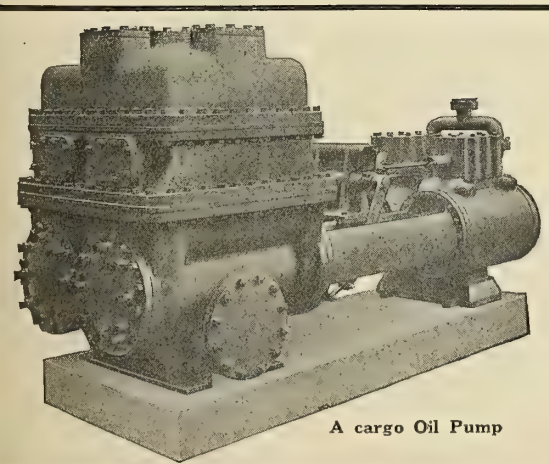

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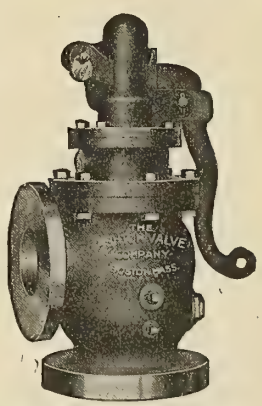

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National Marine Engine Works
Row & Davis, Engineers, Inc.
Warren Steam Pump Co.
Westinghouse Electric & Mfg. Co.
Wheeler Condenser & Eng. Co.
Wheeler Mfg. Co., C. H.
Williams, Wm. E.

Condenser Tubes
Chase Metal Works
Chase Rolling Mill Co.
Kearfott Engineering Co.
Wheeler Condenser & Eng. Co.
Williams, Wm. E.

Conduit Fittings
Crouse-Hinds Co.

Connecting Rods
Pollak Steel Co.
Williams & Co., J. H.

Consulting Engineers
(See Engineers, Consulting)

Conveying Machinery
Lidgerwood Mfg. Co.
McMyler Interstate Co.
Mundy, J. S. Hoisting Eng. Co.

Conveyors (Coal)
(See Conveying Machinery)

CO^2 Ice Machines
(See Conveying Dioxide Machines)

Coolers—Oil Coppers
(See Oil Coolers)

"NACO" Electric Cast Steel
ANCHOR CHAIN CABLE

Meets every requirement of a dependable Anchor Chain Cable

Strength — Tests show the tensile strength of Naco Chain to exceed that of ordinary commercial anchor chain cable, size for size, by over 70%. This great strength makes it possible to furnish Naco Chain to specifications 40% higher than those established on any other type of Anchor Chain Cable.

Resistance to Shock — Subjected to the most severe usage of marine service, Naco Chain has established a new standard of safety for life and property. Because of its great tensile strength and high elastic limit, it withstands without distortion, shocks that destroy ordinary chain cables.

Uniformity — The process of manufacture, by which each link of the same type and size is made off identical patterns, assures absolute uniformity in size and shape of links.

Permanency of Shape — The solid stud cast integral with the link, together with the inherent quality of Naco Steel, which enables Naco Chain to withstand excessive shocks without distortion, protect the permanency of shape of each link throughout the life of the chain.

Ease of Operation — Because of this uniformity and permanency in size and shape of links, Naco Chain always operates smoothly over the wildcat. The casting of the stud solid with the link eliminates the possibility of loose or lost studs and assures against kinking.

Resistance to Corrosion — The corrosive action of salt water is less on Naco Steel than on other chain materials. In tests of long duration, Naco Cable lost less than half as much weight as wrought iron cable exposed to the same conditions. Its homogeneous structure resists the corrosive action, which eats into the fibre or laminations of wrought iron, in constantly increasing areas, and with deeper action than is visible, or can be measured.

Resistance to Wear — Naco Chain has superior wearing qualities. Because of its greater hardness (its Brinnell Number averages 260, as against wrought iron's 110) Naco Chain affords a correspondingly increased resistance to we r and abrasion.

Weight — In weight, size for size, Naco Chain is made the same as wrought iron; insuring the sag required for easy riding at anchor.

Official Rating — Naco Chain carries the official approval of Lloyd's Register of Shipping, American Bureau of Shipping, and the Bureau Veritas, and is furnished to their specifications.

The National Malleable Castings Co.
Cleveland, Ohio

Copper
(See Brass and Copper)

Copper Tubes, Rods, Wires
Chase Metal Works
Chase Rolling Mill Co.
Williams, Wm. E.

Cordage
(Also see Rope and Wire Rope; also Twine)
American Mfg. Co.
Columbian Rope Co.
Griscom-Russell Co.
Plymouth Cordage Co.
Whitlock Cordage Co.
Williams, Wm. E.

Corrugated Furnaces
Continental Iron Works, The

Counters
(See Revolution Counters)
American Steam Gage & Valve Mfg. Co.
Cory, Chas., & Son, Inc.
Schaeffer & Budenburg Mfg. Co.

Couplings
(See Hose Couplings)

Coverings—Non-Conducting
(See Non-conducting Coverings)

Cranes
(Also see Floating Cranes and Shipyards Whirlers)
American Engineering Co.
Brown Hoisting Machinery Co.
Chambersburg Engineering Co.
McMyler Interstate Co.
Niles-Bement-Pond Co.
Shepard Electric Crane & Hoist Co.

Crank Shafts
Pollak Steel Co.
Williams & Co., J. H.

Creosoted Timbers, Piling, Etc.
Long-Bell Lumber Co.

Cutters
Waycott, A. W.
Williams, Wm. E.

Cutting Compounds
Williams, Wm. E.

Cutting and Welding
(See Welding)

Cylinder Boring Bars
Niles-Bement-Pond Co.
Williams & Co., J. H.

Cylinder Relief Valves
(See Valves)

Cylinders for Compressed Air, Gas, Etc.
Continental Iron Works, The
National Tube Co.

Damper Regulators
Atlas Valve Co.

Davits
Stewart Davit & Equip. Corp.

Deck Fittings
Steward Davit & Equip. Corp.
Williams, Wm. E.

Deck Plates
Sands & Son, A. B.
Williams, Wm. E.

Deck Pumps
Sands & Son Co., A. B.
Warren Steam Pump Co.
Williams, Wm. E.

Decking
Long-Bell Lumber Co.
Marine Decking & Supply Co.

Derricks
Lidgerwood Mfg. Co.
McMyler Interstate Co.
J. S. Mundy Hoisting Engine Co.

Derrick Cars
McMyler Interstate Co.

Derrick Irons
Lidgerwood Mfg. Co.
J. S. Mundy Hoisting Engine Co.

Detaching Gear (Boat)
Steward Davit & Equip. Corp.

Diaphragm Pumps
Hyde Windlass Co.

Die Blocks
Pollak Steel Co.

Dies
Brubaker & Bros., W. L.
Cleveland Punch & Shear Works Co.
Williams, Wm. E.

Diesel Engines
(Also see Engines, Oil)
Busch-Sulzer Bros. Diesel Engine Co.
Hadfield-Penfield Steel Co.
Kearfott Engineering Co.
McIntosh & Seymour Corp.
New London Ship & Engine Co.
Winton Engine Works

Direct-Connected Sets
(See Electrical Plants)

Direction and Revolution Indicators
Cory, Chas., & Son, Inc.

Disengaging Gears
Steward Davit & Equip. Corp.

Distillers
(See Evaporators)

Dock Companies
American Balsa Co.

Dock Fittings
Williams, Wm. E.

Draft Gauges
American Steam Gage & Valve Mfg. Co.
Pneumercator Co.
Schaeffer & Budenburg Mfg. Co.
Williams, Wm. E.

Drain Valves
(See Valves)

Drawing Materials
(Board, Cloth, Paper, Ink, Etc.)

Dredges
Morris Machine Works

Dredging Machinery
Alberger Pump & Condenser Co.
American Engineering Co.
Flory Mfg. Co.
Lidgerwood Mfg. Co.
McMyler Interstate Co.
Morris Machine Works
Mundy Hoisting Engine Co., J. S.
National Marine Engine Works

Dredging Pumps
Morris Machine Works
National Marine Engine Works

Drift Pins
Cleveland Punch & Shear Works Co.
Williams, Wm. E.

Drilling Machines
Niles-Bement-Pond Co.

Drills
Rich Tool Co.
Williams, Wm. E.

Drills, Electric
(See Electric Drills)

Drills, Pneumatic
(See Pneumatic Tools)

Drills, Portable
(See Portable Drills)

Drills, Wall Radial
(See Radial Drills)

Drop Forgings
(Eye Bolts, Wrenches, Etc.)
Pollak Steel Co.
Williams & Co., J. H.
Williams, Wm. E.

Drop Hammers
Chambersburg Engineering Co.
Niles-Bement-Pond Co.

Dry Dock Pumps
Morris Machine Works

Dry Docks
(Manufacturer and Marine Railways)
Bethlehem Shipbldg. Corp.
Crandall Engineering Co.

Dry Docks and Marine Railways
Baltimore Dry Docks & Shipbuilding Co.
Bethlehem Shipbuilding Corp., Ltd.
Charleston Dry Dock & Machine Co.
Merchant Shipbuilding Corp.
Staten Island Shipbuilding Corp.
Alex. Stephen & Sons, Ltd.
Sun Shipbuilding Co.
Todd Shipyards Corp.

Dynamos
(See Electric Plants)

Eccentric Rods
Pollak Steel Co.

Economizer, Fuel
(See Fuel Economizer)

Ejectors
Lunkenheimer Co.
Williams, Wm. E.

Electric Cranes
(See Electric Hoists)

Electric Cutouts
Crouse-Hinds Co.

Electric Drills and Grinders
Chicago Pneumatic Tool Co.
General Electric Co.
Williams, Wm. E.

Electric Driven Pumps
Fairbanks-Morse Co.
Ingersoll-Rand Co.

Electric Freight Trucks
(See Freight-Handling)

Electric Heaters
Cory, Chas., & Son, Inc.
General Electric Co.

Electric Hoists
Allan-Cunningham Co.
American Engineering Co.
Brown Hoisting Machinery Co.
Chicago Pneumatic Tool Co.
General Electric Co.
Hyde Windlass Co.
Lidgerwood Mfg. Co.
Maritime Engineering & Sales Corp.
Mead-Morrison Mfg. Co.
Mundy Hoisting Eng. Co., J. S.
Niles-Bement-Pond Co
Shepard Elec. Crane & Hoist Co.

Electric Lighting
Cory, Chas., & Son, Inc.
Crouse-Hinds Co.
General Electric Co.

Electric Meters
(See Meters, Electric)

Electric Plants
Consolidated Shipbuilding Corp.
Cory, Chas., & Son, Inc.
Fairbanks-Morse Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Pumps
(See Electric Driven Pumps)

Electric Signals
Cory, Chas., & Son, Inc.

Electrical Tachometers
Cory, Chas., & Son, Inc.

Electric Welding
(See Welding, Electric)

Electrical Appliances, Installations, Fittings and Supplies
Cory, Chas., & Son, Inc.
Crouse-Hinds Co.
General Electric Co.
Williams, Wm. E.

Electrical Instruments
Cory, Chas., & Son, Inc.
General Electric Co.
Williams, Wm. E.

Electrical Wiring Devices
(Switches, Sockets, Etc.)
Cory, Chas., & Son, Inc.
Williams, Wm. E.

Elevators, Air and Hydraulic
(Also see Portable Elevators)

Engine Logs
Cory, Chas., & Son, Inc.
Williams, Wm. E.

Engine Oil
(See Lubricants)

Engine Packing
(See Packing)

Engine Room Counters
(See Revolution Counters)

Engine Room Telegraphs
Cory, Chas., & Son, Inc.

Engineers, Consulting—Marine
American Engineering Co.
Bogert, J. L.
Bonner, William T.
Cathcart, Wm. L.
Chapman & Fisher
Cox & Stevens
Crandall Engineering Co.
Donnelly, W. T.
Ferris, Theodore
Jansson & Gamon
Jacobs Co., J. L.
Haag, A. H.
Haight, Robert S.
Hansen, Max.
Harris, Leonard B.
Hough, Edward S.
Howden & Co., Ltd.
Leslie Stevens Co.
Lysholm, Henry, Inc.
Matthews, John B.
McClelland & Co., N. E., Ltd.
McKinlay, James
McNab Co., The
Nilson, Leonard J.
Peerless Eng. Co.
Reid & Co., John
Rimmer, A. C
Ross Heater & Mfg. Co.
Row & Davis, Engineers, Inc.
Schutte & Koerting Co.
Sharp, Geo. G.
Tams, Lemoine & Crane
Watts, J. Murray
Whittelsey & Whittelsey

Engineers, Electrical
Cory, Chas., & Son, Inc.

Engines for Auxiliaries
Alberger Pump & Condenser Co.
Consolidated Shipbuilding Corp.
De Laval Steam Turbine Co.
Fairbanks-Morse Co.
Hyde Windlass Co.
Kearfott Engineering Co.
Kerr Turbine Co.
McIntosh & Seymour Corp.
Morris Machine Works
Mundy Hoisting Engine Co., J. S.
New London Ship & Engine Co.
Westinghouse Electric & Mfg. Co.

Engines, Gasoline
(See Gasoline Engines)

Engines, Hoisting
(See Hoisting Engines)

Engines, Kerosene
(See Kerosene Engines)

Engines, Oil
(Also see Diesel Engines)
Busch-Sulzer Bros. Diesel Engine Co.
Chicago Pneumatic Tool Co.
Consolidated Shipbuilding Corp.
Hadfield-Penfield Steel Co.
Ingersoll-Rand Co.
Johnson Iron Works, Ltd.
Kearfott Engineering Co.
McIntosh & Seymour Corp.
New London Ship & Engine Co.
Standard Motor Construction Co.
Winton Engine Co.

Engines, Propelling
American Ship Building Co.
Bath Iron Works
Bethlehem Shipbuilding Corp.
Consolidated Shipbuilding Corp.
Fairbanks-Morse Co.
Hadfield-Penfield Steel Co.
Ingersoll-Rand Co.
Kearfott Engineering Co.
Los Angeles Shipbuilding & Dry Dock Co.
McIntosh & Seymour Corp.
Morris Machine Works
National Marine Engine Works
New London Ship & Engine Co.
Standard Motor Construction Co.
Staten Island Shipbuilding Co.
Trout Co., H. G.
Ward, Chas., Engineering Works
Winton Engine Co.
Worthington Pump & Machinery Corp.

Engines, Pumping
Alberger Pump & Condenser Co.
Davidson Co., M. T.
Fairbanks-Morse Co.
Griscom-Russell Co.
Kearfott Engineering Co.
Morris Machine Works
Row & Davis, Engineers, Inc.
Worthington Pump & Machinery Corp.

Engine-Room Clocks
(See Clocks)

STEWARD

Life-saving Equipment

"Safety at Sea"

Gear engaged.

The Use of Our Boat Release Gear Guarantees

1—Simultaneous Release under full load
2—Simultaneous Release partially waterborne
3—Simultaneous Release under no load
4—One man unhooking by hand
5—One man hooking on by hand
6—No resistance to towing strain
7—No cast metal taking load
8—No safety pins required
9—GUARANTEES AGAINST *PREMATURE RELEASE*

Gear released.

STEWARD BOAT RELEASING GEAR

Patented—October 16, 1918.
December 17, 1918.

Simultaneous release of both ends of a life boat is important enough under fair weather conditions in quiet water, but under the stress of storm and forced embarkation in heavy seas, with perhaps headway on the ship, every life aboard is in jeopardy until the boat is safely released.

The Steward Gear will release when needed—never before. It cannot "unhook itself." It is stronger than any other part of the boat falls equipment, cannot get out of order, freeze up or jam.

Write for full details of tests

STEWARD DAVIT & EQUIPMENT CORPORATION

17 Battery Place, N. Y. **Factory: Hudson, N. Y.**

Seattle San Francisco London

Engine-Room Supplies
(See Steam Specialties)

Engine Room Telegraphs
Williams, Wm. E.

Engrave Stem Thermometers
Taylor Instrument Companies

Evaporators
Alberger Pump & Condenser Co.
American Engineering Co.
Davidson Co., M. T.
Griscom-Russell Co.
Kearfott Engineering Co.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Exhaust Fans
(See Blowers)

Expanders
(See Boiler Flue Expanders and Pipe Expanding and Flanging Machines)

Expansion Joints
Alberger Pump & Condenser Co.
Crane Co., The
Griscom-Russell Co.
Lunkenheimer Co.
Powell Co., The William

Eye Bolts
Williams & Co., J. H.
Williams, Wm. E.

Fans
(See Blowers)

Feed Water Heaters
Griscom-Russell Co.
Kearfott Engineering Co.
Pratt & Cady Co., Inc.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Feed Water Regulators
Alberger Pump & Condenser Co.
Jerguson Gage & Valve Co.
Kearfott Engineering Co.
Pratt & Cady Co., Inc.

Fences
(See Wire Fences)

Ferrules—Condenser Tube
(See Condenser Tube Ferrules)

Files
Williams, Wm. E.

Filters—Marine Oil
Griscom-Russell Co.
Kearfott Engineering Co.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Fire Alarm Systems
Cory, Chas., & Son, Inc.
Kidde Co., Inc., Walter

Fire Department Supplies
Kidde Co., Inc., Walter

Fire Extinguishers
Kidde Co., Inc., Walter
Williams, Wm. E.

Fire Hose
(See Hose)

Fireproof Lumber
(See Lumber, Fireproof)

Fire Pumps
Morris Machine Works
Warren Steam Pump Co.

Flags and Pennants
Williams, Wm. E.

Flanged Boiler Heads
Lukens Steel Co.

Flanges
American Spiral Pipe Wks.
Crane Co., The
Lunkenheimer Co., The
Williams, Wm. E.

Flanging Machines
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
Watson-Stillman Co.
Williams Co., J. H.

Floating Cranes
(Also see Cranes)
McMyler-Interstate Co.

Float Valves
Atlas Valve Co.
Crane Co., The
Lunkenheimer Co., The

Floating Dry Docks
(See Dry Docks)

Floor Plates
Crane Co., The

Flue Cleaners
(See Boiler Flue Cleaners)

Flue Cutters
(See Boiler Flue Cutters)

Flue Hole Punches and Dies
Cleveland Punch & Shear Works Co.

Fog Horns
Cory, Chas., & Son, Inc.
Williams, Wm. E.

Forced Draft
(See also Blowers)
De Laval Steam Turbine Co.
General Electric Co.
Kearfott Engineering Co.
Kerr Turbine Co.

Forges
Buffalo Forge Co.

Forgings, Bronze
Hyde Windlass Co.
Pollak Steel Co.

Forgings—Drop
(See Drop Forgings)

Forgings, Iron and Steel
(Also see Drop Forgings)
Charleston Dry Dock & Machine Co.
Pollak Steel Co.

Forgings—Monel Metal
International Nickel Co.

Freight-Handling Equipment
Brown Hoisting Machinery Co.
General Electric Co.
Lidgerwood Mfg. Co.
McMyler Interstate Co.
Mundy, J. S., Hoisting Engine Co.
Shepard Electric Crane & Hoist Co.

Fuel Economizer
Griscom-Russell Co.
Magnesia Association of America

Fuel Oil
Standard Oil Co. (New Jersey)
Sun Co.

Fuel Oil Burners
White Fuel Oil Engineering Corp.
Williams, Wm. E.

Fuel Oil Heaters
Griscom-Russell Co.
Williams, Wm. E.

Fuel Oil Pumps
Davidson Co., M. T.
Warren Steam Pump Co.

Furnace Bridge Walls
Wagner Furnace Bridge Wall Co., Inc.

Furnace Cement
Waycott, A. K.

Furnace Fronts
Continental Iron Works, The

Furnaces
(Also see Oil Furnaces)
American Spiral Pipe Wks.
Continental Iron Works, The

Fuses
Crouse-Hinds Co.

Fusible Plugs
Crane Co., The
Griscom-Russell Co.
Lunkenheimer Co., the
Williams, Wm. E.

Galley Pumps
Mott Iron Works, J. L.
Sands & Son, Co., A. B.
Williams, Wm. E.

Galleys
(See Ranges)

Galvanized Material
Sands, A. B., & Son Co.
Tiebout, W. & J.
Williams, Wm. E.

Gantry Cranes
Niles-Bement-Pond Co.

Gas Compressors
Norwalk Iron Works

Gas Engine Specialties
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady Co., Inc.

Gas Thermometers
Schaeffer & Budenburg Mfg. Co.

Gaskets
(Also see Packing)
Crane Co., The
Goetze Gasket & Packing Co.
Griscom-Russell Co.
Williams, Wm. E.

Gasoline Engines
Consolidated Shipbuilding Corp.
Fairbanks-Morse Co.
Standard Motor Construction Co.
Winton Engine Co.

Gasoline Pumps
Sands & Son Co., A. B.

Gate Valves — Brass and Iron
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady, Inc.
Williams, Wm. E.

Gate Valves for Tank Steamers
Pratt & Cady Co., Inc.
Williams, Wm. E.

Gauge Boards
American Steam Gage & Valve Mfg. Co.
Schaeffer & Budenburg Mfg. Co.

Gauge Cocks
American Steam Gage & Valve Mfg. Co.
Jerguson Gage & Valve Co.
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady Co., The
Sands & Son Co., A. B.
Williams, Wm. E.

Gauge Glasses
Crane Co, The
Jerguson Gage & Valve Co.
Lunkenheimer Co., The
Powell Co., The William
Schaeffer & Budenburg Mfg. Co.
Williams, Wm. E.

Gauges
(See Draft Gauges; also Tank Gauges)

Gauge Testers
American Steam Gage & Valve Mfg. Co.
Schaeffer & Budenburg Mfg. Co.

Gauges—Manufacturers'
(Also see Steam Gauges)

Gears
De Laval Steam Turbine Co.
Falk Corp., The
Kerr Turbine Co.
Westinghouse Electric & Mfg. Co.

General Welding and Cutting Equipment
(See Welding & Cutting Apparatus and Supplies)

Generating Sets
Engberg's Electric & Mechanical Wks.
Fairbanks-Morse Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.
Williams, Wm. E.

Generators
Crouse-Hinds Co.
Engberg's Electric & Mechanical Wks.
Fairbanks-Morse Co.
General Electric Co.
Williams, Wm. E.

Globe Valves—Brass and Iron
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady Co., Inc.
Williams, Wm. E.

Glue—Marine
Williams, Wm. E.

Governor Valves
Atlas Valve Co.
Crane Co., The
Lunkenheimer Co., The
Williams, Wm. E.

Governors
Atlas Valve Co.
Cory, Chas., & Sons, Inc.

Grease
(See Lubricants)

Grease Cups
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Sun Co.

Grease Extractors
American Steam Gage & Valve Mfg. Co.
Griscom-Russell Co.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Grinders—Electric and Pneumatic
Chicago Pneumatic Tool Co.

Guillotine Shears
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.

Guy Anchors
Crouse-Hinds Co.

Gypseys
American Engineering Co.
Hyde Windlass Co.
Lidgerwood Mfg. Co.
Mundy Hoisting Engine Co., J. S.

Gyro-Compassess
Sperry Gyroscope Co.

Gyro-Stabilizers
Sperry Gyroscope Co.

Hammers
Bradley & Son, C. C.

Hammers, Pneumatic
(See Pneumatic Tools)

Hammers, Steam
Chambersburg Eng. Wks.
Niles-Bement-Pond Co.

Hammocks
(See Couch Hammocks)

Handles (Crank, Balance, Machine)
Williams & Co., J. H.

Hardware
(See Marine Hardware)

Hardwood
(See Lumber)

Hawser Reels
Williams, Wm. E.

Hawsers—Manila
(Also see Rope and Wire Rope)
American Mfg. Co.
Columbian Rope Co.
Plymouth Cordage Co.
Whitlock Cordage Co.
Williams, Wm. E.

Heat Insulation
(Also see Non-Conducting Coverings)
Magnesia Association of America

Heaters
(Bath, Lavatory, Shower)
Alberger Pump & Condenser Co.
Griscom-Russell Co.
Kearfott Engineering Co.
Mott Iron Works, J. L.
Pratt & Cady Co., The
Sands & Son Co., A. B.
Williams, Wm. E.

Hemp
(See Twine)

Hoist Hooks
Williams, J. H., & Co.
Williams, Wm. E.

Hoisting Engines
Allan-Cunningham Co.
American Engineering Co.
Fairbanks-Morse Co.
Flory Manufacuring Co., S.
Hadfield-Penfield Steel Co.
Hyde Windlass Co.
Lidgerwood Mfg. Co.
Maritime Engineering & Sales Corp.
Mundy Hoisting Engine Co., J. S.

BUNKER FUEL OIL

This Company is in a position to offer to the Shipping interests world-wide facilities for bunkering with "Standard" Fuel Oil. This service makes possible the decided economies resulting from the use of "Standard" Fuel Oil.

Ports at which deliveries can be made through arrangements with the Standard Oil Company (New Jersey), 26 Broadway, N. Y.

UNITED STATES

Atlantic and Gulf Ports

*New York
Boston
*Philadelphia
*Baltimore
*Norfolk
*Charleston
*New Orleans
*Baton Rouge

Pacific Coast Ports

Tacoma
*Seattle
Ketchikan
Aberdeen
*Point Wells
Portland
Astoria
*Richmond
Eureka
*San Francisco
*San Pedro
San Diego
*Honolulu

CANADA

*Halifax
*Montreal
*Quebec
*Vancouver
Prince Rupert

WEST INDIES

Havana
Cienfuegos
Nuevitas
San Juan
Bermuda
Curacao
St. Thomas

SOUTH AMERICA

Rio de Janeiro
Montevideo
Valparaiso
*Campana
*Buenos Aires
*Talara

UNITED KINGDOM

*Purfleet
*Manchester
*Southampton
*Newcastle-On-Tyne
*Liverpool
*Brixham
Hull

GERMANY

Hamburg
Nordenham

AFRICA

Bizerta

MEXICO

Tampico

PANAMA CANAL

Cristobal
*Balboa

TURKEY

Constantinople

GREECE

Piraeus

CHINA

Hong Kong
Shanghai

*Diesel oil also available

Arrangements will shortly be completed to cover ports in addition to those listed, as follows:

Fort William, Ont.
Hamilton, Ont.
Sarnia, Ont.
St. John, N. B.
Victoria, B. C.
Toronto, Ont.
Antilla, Cuba
Matanzas, Cuba
Antofagasta, Chile
Iquique, Chile
Pisagua, Chile
Tocopilla, Chile
Taltal, Chile
Paita, Peru
Callao, Peru
Bahia Blanca, Arg.
Ponta Delgada, Azores
Bergen, Norway
Christiania, Norway
Vallo, Norway
Gothenburg, Sweden
Helsingfors, Finland
Aalborg, Denmark
Copenhagen, Denmark
Nyborg, Denmark
Avonmouth, U. K.
Birkenhead, U. K.
Cardiff, U. K.
Newcastle, U. K.
Sunderland, U. K.
Rotterdam, Holland
Amsterdam, Holland
Antwerp, Belgium
Rouen, France
Havre, France
Marseilles, France
Dunkirk, France
La Pallice, France
Genoa, Italy
Monopoli, Italy
Portici, Italy
Savona, Italy
Venice, Italy
Port Said, Egypt
Alexandria, Egypt
Colombo, Ceylon
Singapore, S. S.
Itosaki, Japan
Nagasaki, Japan
Sydney, Australia
Wellington, N. Z.
Durban, S. A.

STANDARD OIL COMPANY (New Jersey)

26 Broadway, New York

Hoisting and Transmission Rope
(See Rope)

Hoists, Chain
(See Chain Hoists)

Hoists, Electric
(See Electric Hoists)

Holders-On
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hollow Boring
Pollak Steel Co.

Horizontal Punches
Cleveland Punch & Shear Works Co.

Hose
(Also see Air Hose)
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hose Coupling
Chicago Pneumatic Tool Co.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

Humidifiers
Griscom-Russell Co.

Hydraulic Fittings
Crane Co., The
Lunkenheimer Co.
Powell Co., The William
Watson-Stillman Co.

Hydraulic Presses and Other Machinery
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
Warren Steam Pump Co.
Watson-Stillman Co.

Hydraulagraph
American Steam Gage & Valve Mfg. Co.

Hydrometers
Taylor Instrument Companies

Hygrodeiks
Taylor Instrument Companies

Hygrometers
Taylor Instrument Companies

Hygrostats
Atlas Valve Co.

Ice Machines
(See Refrigerating Machinery)

Indicator Connections
Lunkenheimer Co.
Powell Co., The William

Indicators
(Steam and Gas Engine)
American Steam Gage & Valve Mfg. Co.
Ashton Valve Co.
Cory, Chas., & Son, Inc.
Lunkenheimer Co., The
Manning, Maxwell & Moore, Inc.
Powell Co., The William
Williams, Wm. E.

Indicating & Recording Thermometers
Schaeffer & Budenburg Mfg. Co.

Taylor Instrument Companies

Inspectors Outfits
American Steam Gage & Valve Mfg. Co.

Injectors
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Interlocking Rubber Tiling
Griscom-Russelll Co.

Iron Pipe
(See Pipe)

Jacks
(Pneumatic)
Gracey, R., & Sons Co.
Watson-Stillman Co.

Jacks, Hydraulic
Watson-Stillman Co.

Jacks—Steamboat Ratchet (Pulling)
Gracey, R., & Sons Co.
Griscom-Russell Co.

Journal Bearings
(See Thrust Bearings)

Jute
American Mfg. Co.
Columbian Rope Co.

Kerosene Engines
Consolidated Shipbuilding Corp.
Fairbanks-Morse Co.
Standard Motor Construction Co.

Knife Switches
Crouse-Hinds Co.

Ladder Treads
Williams, Wm. E.

Lamps, Signals and Fixtures
Cory, Chas., & Son, Inc.
General Electric Co.
Sands, A. B. & Son Co.
Westinghouse Electric & Mfg. Co.
Williams, Wm. E.

Lathe Dogs
Williams & Co., J. H.
Williams, Wm. E.

Lathes, Crank Shaft, Engine and Turret
Niles-Bement-Pond Co.

Launches and Yachts
(See shipbuilders)

Launching Grease
Sun Co.

Lavatories
(Stateroom)
Crane Co., The
Mott Iron Works, J. L.
Sands, A. B., & Son Co.
Williams, Wm. E.

Lavatory and Bath Heaters
Griscom-Russell Co.
Sands, A. B., & Son Co.
Williams, Wm. E.

Lead Pencils
(See Drawing Pencils)

Leather Belting
Williams, Wm. E.

Life Boats and Rafts
Lane Lifeboat Co., C. M.
Steward Davit & Equip. Corp.
Williams, Wm. E.

Life Preservers
Williams, Wm. E.

Life-Saving Devices
Steward Davit & Equip. Corp.

Lighting Sets
(See Electric Plants)

Lights, Electric
(See Electric Lights)

Lines—Towing, Buoy
(See Rope)

Loading and Unloading Equipment
(See Freight-Handling Equipment)

Locks and Latches
(See Ship Locks and Latches)

Locomotive Cranes
(See Cranes)

Lowering Control
American Balsa Co.

Log Registers
Steward Davit & Equip. Corp.

Lubricants
Standard Oil Co. (New Jersey)
Sun Co.
Wadsworth, Howland & Co.

Lubricating Oil Pumps
Warren Steam Pump Co.

Lubricators
Crane Co.
Griscom-Russell Co.
Lunkenheimer Co.
Powell Co., The William
Sun Co.
Williams Valve Co., D. T.

Lumber
Long-Bell Lumber Co.

Machine Tools
Cleveland Pneumatic Tool Co.
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.

Machinists' Tools
Williams & Co., J. H.

Manganese Bronze Castings
American Manganese Bronze Co.
Columbian Bronze Corp.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co.
Powell Co., The William

Magnesia Goods and Materials
Magnesia Association of America

Malleable and Steel Castings
Crane Co.

Manila and Sisal Rope
(See Rope)

Manifolds
Cleveland Pneumatic Tool Co.

Manufacturing Plants
(See Builders)

Marine Boiler Heads
(See Boiler Heads)

Marine Cableways
Lidgerwood Mfg. Co.

Marine Coatings
(See Anti-Rust Coastings)

Marine Decking
(See Decking)

Marine Electrical Equipment
(See Electrical Fittings and Supplies)

Marine Engines
(See Engines, Propelling)

Marine Engineers
(See Engineers, Consulting)

Marine Forgings
(See Forgings)

Marine Glue
Williams, Wm. E.

Marine Hardware
Consolidated Shipbuilding Corp.
Sands & Son Co., A. B.
Tiebout, W. & J.
Williams, Wm. E.

Marine Heaters
(See Heaters)

Marine Inter-Communication Equipment
Cory, Chas., & Son, Inc.

Marine Lighting Sets
(See Electric Plants)
Williams, Wm. E.

Marine Paint
(Also see Paint)
Briggs Bituminous Composition Co., Inc.
Federal Composition & Paint Co., Inc.
Wadsworth, Howland & Co.
Wailes Dove - Hermiston Corp.
Williams, Wm. E.

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Crane Co., The
Mott Iron Works, J. L.
Sands & Son Co., A. B.

Marine Railway Builders
Crandall Engineering Co.

Marine Railways
(See Dry Docks)

Marine Ranges
(See Ranges)

Marine Refrigeration
(See Refrigerating Machinery)

Marine Repairs
(See Shipbuilders)

Marine Securities
Marine Corporation

Marine Shafting
(See Shafting)

Marine Specialties
(See Steam Specialties)

Marine Superheaters
Babcock & Wilcox Co.
Heine Safety Boiler Co.
Power Specialty Co.
Superheating Co., The

Marine Supplies
Tiebout, W. & J.
Williams, Wm. E.

Marine Wiring Devices
Cory, Chas., & Son, Inc.
General Electric Co.

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National Tube Co.

Mattresses
Southern-Rome Co.

Mechanical Telegraphs
Cory, Chas., & Son, Co.
Radio Corporation of America
Williams, Wm. E.

Mercury Pressure Gauges
American Steam Gage & Valve Mfg. Co.

Metallic Packing
(Also see Packing)
Goetze Gasket & Packing Co.
U. S. Metallic Packing Co.

Meters, Electric
General Electric Co.

Milling Machines
Niles-Bement-Pond Co.

Mineral Wool
(See Non-Conducting Covering)

Monel Metal
International Nickel Co.

Mooring Engines
American Engineering Co.
Flory Mfg. Co., S.
Hyde Windlass Co.
Lidgerwood Mfg. Co.

Motor Boats
(See Launches and Yachts)

Motor Boat Supplies
Tiebout, W. & J.
Williams, Wm. E.

Motors, Electric
General Electric Co.

Motors, Gasoline
(See Gasoline Engines)

Multiple Drills
Niles-Bement-Pond Co.

Multiple Punches
Cleveland Punch & Shear Works
Niles-Bement-Pond Co.

Multiwhirl Oil Coolers
Griscom-Russell Co.

Nautical Instruments
McNab Co., The
Sperry Gyroscope Co.
Williams, Wm. E.

Naval Architects
Bogert, John L.
Cathcart, Wm. L.
Chapman & Fisher
Cox & Stevens
Donnelly, William T.
Ferris, Theodore
Jansson & Gamon
Jacobs Co., J. L.
Haag, A. H.
Haight, Robert S.
Hansen, Max
Harris, Leonard B.
Hough, Edward S.
Lysholm, Henry, Inc.
McClelland, N. E., & Co., Ltd.
McKinlay, James
Matthews, John B.
Nilson, Leonard J.
Peerless Eng. Co.
Rimmer, A. C.
Sharp, Geo. G.
Tams, Lemoine & Crane
Watts, J. Murray
Whittelsey & Whittelsey

Needle Valves
(See Valves)

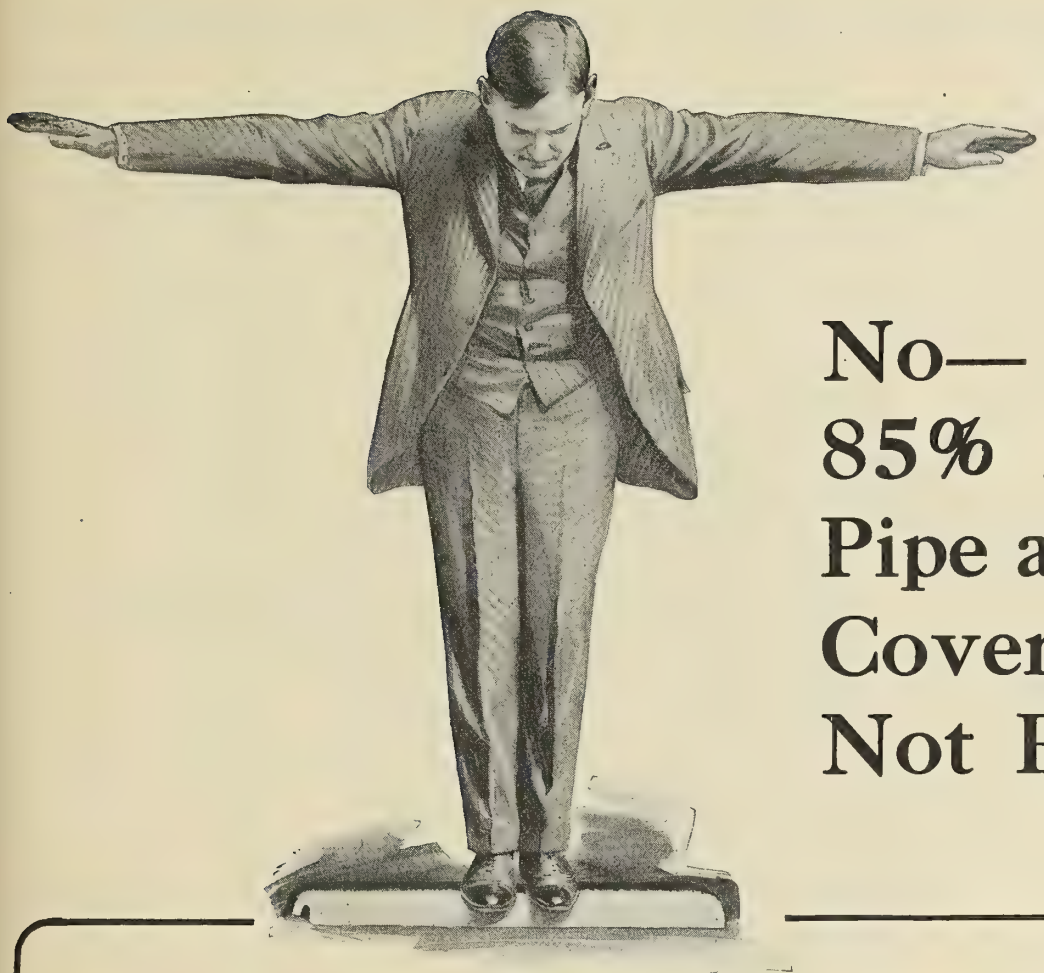
Nipples
Crane Co., The
Lunkenheimer Co., The

Non-Conducting Coverings
Magnesia Association of America
Thorsen, P. S., & Co., Inc.

Nozzles
(See Hose Nozzles)

Nuts
(See Bolts and Nuts)
Russell, Burdsall & Ward Bolt and Nut Co.
Williams, Wm. E.

Oakum
American Mfg. Co.



No— 85% Magnesia Pipe and Boiler Covering Is Not Fragile

Nearly everybody jumps to the conclusion that an article of light weight has little strength. The thoughts are naturally associated.

But the truth is that 85% Magnesia combines light weight and strength.

The illustration above, sketched from a photograph, shows a heavy man standing on a half section of 85% Magnesia Pipe Covering. Had you any idea that 85% Magnesia possessed such strength?—Do you doubt it? Then try it yourself.

Pipe coverings need not hang in shreds on the pipe to be considered as having failed. **The most frequent failure is sagging.** If the covering sags only ¼ of an inch it has failed.

As weight induces sagging, it is extremely important that a pipe covering be as light as possible. The rigidity of 85% Magnesia holds each section snugly to the pipe.

85% Magnesia combines light weight with great strength; one feature is not sacrificed for the other. This is one reason—only one—why 85% Magnesia is the **Universal** Coal Saver.

Other vital facts with respect to insulation are given in our revised book "Defend Your Steam," furnished free to every responsible person.

MAGNESIA ASSOCIATION of AMERICA

753 BULLETIN BUILDING **PHILADELPHIA, PENNSYLVANIA**

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Oil
(See Lubricants)

Oil Burners, Fuel
(See Fuel Oil Burners)

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Bethlehem Shipbldg. Corp.
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White Fuel Oil Engineering Corp.
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Lunkenheimer Co., The
Powell Co., The William
Sun Co.
Williams, Wm. E.

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Sun Co.

Oil Fuel Apparatus
(See Oil-Burning Equipment)

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Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Oil Heaters and Coolers
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Row & Davis, Engineers, Inc.

Oil Pumps
Davidson, M. T., Co.
Ingersoll-Rand Co.
Lunkenheimer Co., The
Powell Co., The William
National Transit Pump & Machine Co.
Sands, A. B., & Son, Co.
Warren Steam Pump Wks.

Oil Purifiers
De Laval Separator Co.
Griscom-Russell Co.

Oil Tankers
(See Tank Ships)

Oiling Systems
(Also see Lubricants)
Lunkenheimer Co., The
Powell Co., The William

Ore-Handling Machinery
(See Coal-Handling Machinery)

Oxy-Acetylene Welding and Cutting
Prest-O-Lite Co., Inc.
Vulcan Iron Works, Inc.

Oxygen
Linde Air Products Co.
Prest-O-Lite Co.

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(Also see Metallic Packing and Ammonia Packing)
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United States Metallic Packing Co.
Williams, Wm. E.

Packing, Asbestos
Crane Co.
Williams, Wm. E.

Packings, Leather
Watson-Stillman Co.

Paint
Federal Composition & Paint Co.
Marine Decking & Supply Co.
Wadsworth, Howland & Co.
Wailes Dove-Hermiston Corp.
Williams, Wm. E.

Paint Spraying Equipment
(See Pneumatic Paint Spraying Equipment)

Panel Boards
(Marine)
Cory, Chas., & Son, Co.
Crouse-Hinds Co.

Panelling
(Marine Fireproof)
Marine Decking & Supply Co.

Pantographs
American Steam Gage & Valve Mfg. Co.

Partitions
(Marine Fireproof)
Marine Decking & Supply Co.

Pencils
(See Drawing Pencils)

Phosphor Bronze Castings
American Manganese Bronze Co.
Columbian Bronz Corp.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co., The

Pile Drivers
Flory, S., Mfg. Co.
Lidgerwood Mfg. Co.
McMyler-Interstate Co.
Mundy Hoisting Eng. Co., J. S.

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National Tube Co.
Watson-Stillman Co.
Williams, Wm. E.

Pipe Bending Machines
Buffalo Forge Co.
Watson-Stillman Co.

Pipe Covering
(See Non-Conducting Covering)

Pipe Cutting and Threading Machine
Niles-Bement-Pond Co.
Williams, Wm. E.

Pipe Elbows
Atlas Valve Co.

Pipe Expanding and Flanging Machines
Watson-Stillman Co.

Pipe Flanges
(See Flanges)

Pipe Fittings
Atlas Valve Co.

Pipe Unions
Atlas Valve Co.
Crane Co.
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Pipe Wrenches
Williams & Co., J. H.
Williams, Wm. E.

Piston Rings
(See Packings)

Piston Rods
Pollak Steel Co.

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(Metal Working)
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Niles-Bement-Pond Co.

Planimeters
American Steam Gage & Valve Mfg. Co.
Williams, Wm. E.

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(See Rolls, Bending & Straightening)

Plate Castors
(See Castors)

Plate Shears
The Quickwork Co.

Plates
(See Steel Plates and Shapes)

Plugs and Receptacles—Watertight
Cory, Chas., & Son, Inc.
Williams, Wm. E.

Plumbago
(Also see Graphite)
Williams, Wm. E.

Plumbers' Tools
Williams & Co., J. H.
Williams, Wm. E.

Plumbing
(See Marine Plumbing)

Pneumatic Drills
(See Pneumatic Tools)

Pneumatic Hammers
(See Pneumatic Tools)

Pneumatic Hose
(See Air Hose)
Sands, A. B., & Son, Co.

Pneumatic Riveters
Ingersoll-Rand Co.
Keller Pneumatic Tool Co.
Watson-Stillman Co.

Pneumatic Separators
Griscom-Russell Co.

Pneumatic Tools
Cleveland Pneumatic Tool Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Pop Safety Valves
American Steam Gage & Valve Mfg. Co.
Ashton Valve Co.
Crane Co.
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Poppet Valves
(See Valves)

Portable Drills
General Electric Co.

Portable Elevators
(For Handling Bulk Materials)

Port Lights
(See Air Ports)

Power Hammers
Chambersburg Engineering Co.
The Quickwork Co.

Power Punches
Watson-Stillman Co.

Power Punches and Shears
Buffalo Forge Co.
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.

Power Riveters
Cleveland Punch & Shear Works Co.
Ingersoll-Rand Co.
Niles-Bement-Pond Co.
Watson-Stillman Co.

Power Shears
Buffalo Forge Co.
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.
Quickwork Co.

Presses
(See Hydraulic Presses)

Pressure Gauges
Schaeffer & Budenburg Mfg. Co.

Pressure Regulators
Ashton Valve Co.
Atlas Valve Co.
Crane Co.
Lunkenheimer Co., The
Powell Co., The William

Professional Cards
Ansell & Bailey
Bogert, John L.
Bonner, William T.
Cathcart, Wm. L.
Chapman & Fisher
Ferris, Theodore
Jacobs Co., J. L.
Jansson & Gamon
Haag, A. H.
Haight, Robert S
Hough, Edward S
Lysholm, Henry, Inc.
Matthews, John B.
McClelland, N. E., & Co., Ltd.
Nilson, Leonard J.
Pommer, Walter E.
Tams, Lemoine & Crane
Peerless Eng. Co.
Sharp, Geo. G.
Watts, J. Murray
Whittelsey & Whittelsey

Projectors
(See Searchlights)

Propeller Shafts
(See Shafting)

Propeller Wheels
American Manganese Bronze Co.
Bethlehem Shipbldg. Corp.
Columbian Bronze Corp.
Donnelly, Wm. T.
Hyde Windlass Co.
Kearfott Engineering Co.
Trout Co., H. G.

Pump Governors
Atlas Valve Co.
Williams, Wm. E.

Pumping Machinery
(See Engines, Pumping)

Pumps
Alberger Pump & Condenser Co.
Bethlehem Shipbldg. Corp.
Chambersburg Engineering Co.
Davidson Co., M. T.
De Laval Steam Turbine Co.
Fairbanks-Morse Co.
Griscom-Russell Co.
Hyde Windlass Co.
Ingersoll-Rand Co.
Kerr Turbine Co.
Morris Machine Works
National Transit Pump & Machine Co.
Row & Davis, Engineers, Inc.
Sands & Son, Co., A. B.
Warren Steam Pump Co.
Watson-Stillman Co.
Wheeler Condenser & Eng. Co.
Wheeler Mfg. Co., C. H.
Westinghouse Electric & Mfg. Co.
Williams, Wm. E.

Punching Machines
(See Power Punches)

Punches and Dies
Cleveland Punch & Shear Works Co.

Punches, Shears and Bar Cutters Combined
Buffalo Forge Co.

Punching and Shearing Machines
(See Power Machines and Shears)

Punch Tables
(See Spacing Tables)

Push Buttons
Cory, Chas., & Son, Inc.

Pyrometers
Superheater Co., The
Taylor Instrument Companies
Williams, Wm. E.

Quadrant Davits
(See Davits)

Radial Drills
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.

Radio Apparatus
Radio Corporation of America

Rafts
(See Lifeboats and Rafts)

Railway Dry Docks
Crandall Engineering Co.

Ranges
Sands, A. B. & Sons Co.

Ratchet Jacks
(Pulling and Pushing)
Gracey & Sons Co., R.

Reamers
Brubaker & Bros., W. L.
Chicago Pneumatic Tool Co.

Reclaiming Systems For Oil
De Laval Separator Co.

Recording Instruments
(Also see Steam Gauges)
Taylor Instrument Companies

Recording Gauges
Schaeffer & Budenburg Mfg. Co.

Reducing Gears
(See Gears)

Reducing Valves
Atlas Valve Co.
Crane Co.
Lunkenheimer Co., The
Williams, Wm. E.

Reflex Water Gauges
Jerguson Gage & Valve Co.

Refrigerating Machinery
Brunswick Refrigerating Co.
Frick Co.
Norwalk Iron Works
Westinghouse Electric & Mfg. Co.
York Mfg. Co.

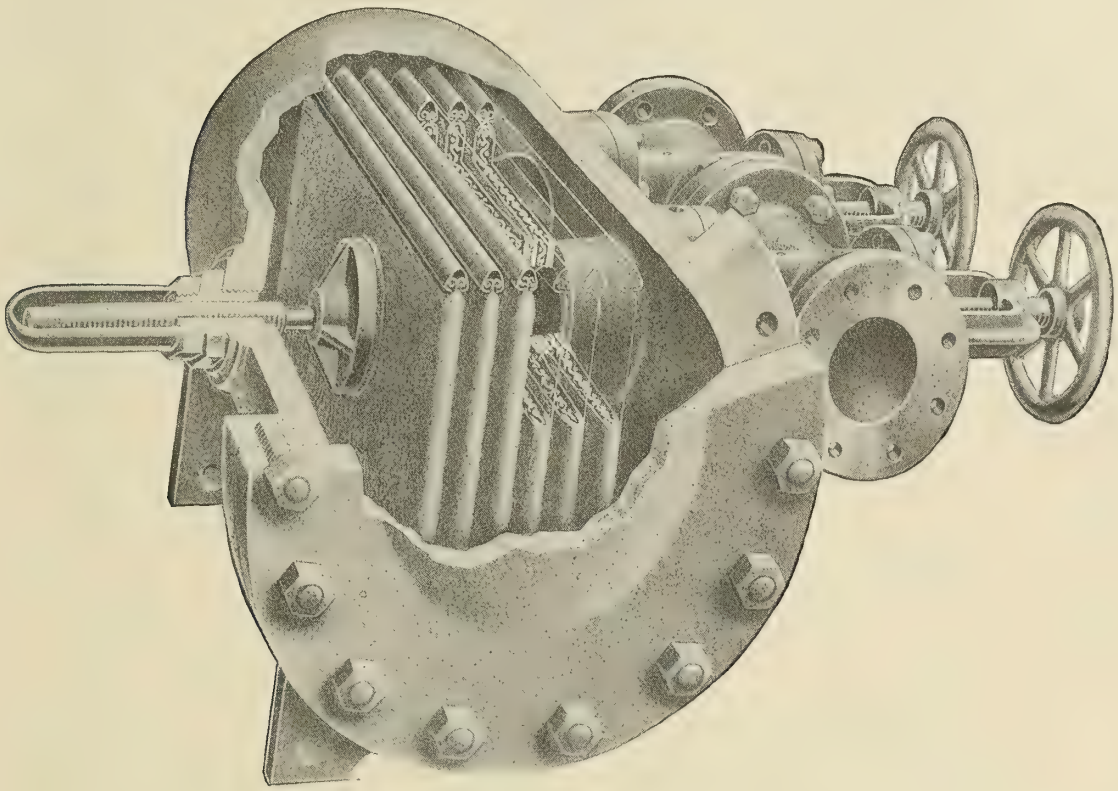
Regulating Valves
Atlas Valve Co.
Crane Co.
Lunkenheimer Co.
Powell Co., The William
Sands, A. B., & Son, Co.
Williams, Wm. E.

Releasing Gear
Steward Davit & Equip. Corp.

Relief Valves
Atlas Valve Co.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Crane Co.
Lunkenheimer Co., The
Powell Co., The William
Watson-Stillman Co.
Williams, Wm. E.

Repairs, Marine
Bethlehem Shipbldg. Corp.

G-R Multiscreen Filter



KEEPS OIL OUT

of the Boiler

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Milwaukee

Revolution Counters
Ashton Valve Co.
Cory, Chas., & Son, Inc.
Schaeffer & Budenburg Mfg. Co.
Williams, Wm. E.

Rheostats
General Electric Co.

Rigging
(See Rope; also Wire Rope)

River Boats
(See Shipbuilders)

Rivets
Carlin, Anthony
Champion Rivet Co.
Severance Mfg. Co., S.

Rivet Busters, Rivet Clamps and Rivet Tongs
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Riveters
(See Pneumatic Riveters and Power Riveters)

Riveting Machines, Hydraulic and Steam Power
(Also see Power Riveters and Pneumatic Riveters)
Chambersburg Engineering Co.
Chicago Pneumatic Tool Co.
Niles-Bement-Pond Co.

Rod and Yoke Ends
Williams, Wm. E.

Rods (Brass)
Chase Metal Works
Chase Rolling Mill Co.
Williams, Wm. E.

Rods (Steel)
Pollak Steel Co.

Rods, Welding
(See Welding Rods)

Roll and Pitch Recorders
Sperry Gyroscope Co.

Rolled Zinc
Williams, Wm. E.

Roller Bearings
Bantam Ball Bearing Co.

Rolls, Bending and Straightening
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.
Pollak Steel Co.

Rolling Sheet Metal Machines
The Quickwork Co.

Rope
(Also see Wire Rope)
American Mfg. Co.
Columbian Rope Co.
Plymouth Cordage Co.
Wall Rope Works, Inc.
Whitlock Cordage Co.

Rope Transmission
American Mfg. Co.
Columbian Rope Co.
Wall Rope Works, Inc.
Whitlock Cordage Co.

Rotary Blowers
(See Blowers)

Rotary Pumps
Sands, A. B., & Son, Co.

Rotary Shears
Quickwork Co., The

Rowboats
(See Launches and Yachts)

Rubber Goods
(Also see Packing; also see Interlocking Rubber Tiling)
Williams, Wm. E.

Rubber Tiling
(See Interlocking Rubber Tiling)

Rudder Posts
Williams, Wm. E.

Safety Devices
(See Life Saving Devices)

Safety Valves
(See Valves)

Sanitary Fittings
(See Plumbing)

Sanitary Pumps
Davidson Co., M. T.
Morris Machine Works
Sands, A. B., & Son, Co.
Warren Steam Pump Co.

Scales—All Kinds
Fairbanks-Morse Co.

Screw Plates
Williams, Wm. E.

Screw Punches
Cleveland Punch & Shear Works Co.

Scuttles
Steward Davit & Equip. Corp.

Seamless Steel Tubes
National Tube Co.

Searchlights
Crouse-Hinds Co.
General Electric Co.

Sentinel Valves
(See Valves)

Shaft Steel
(See Steel Shafting)

Shafting
(Seamless Steel)
Kearfott Engineering Co.
National Tube Co.
Pollak Steel Co.
Williams, Wm. E.

Shafting— Bronze
American Manganese Bronze Co.
Chase Metal Works
Chase Rolling Mill Co.

Shafts—Propeller
Pollak Steel Co.

Shapes
(Rolled Steel)
Pollak Steel Co.

Shearing Machines
(See Power Shears)
The Quickwork Co.

Sheet Metal Working Machines
The Quickwork Co.

Sheet Metal Shears
The Quickwork Co.

Shipbuilders and Dry Dock Companies
Baltimore Dry Docks & Shipbuilding Co.
Bath Iron Works
Bethlehem Shipbuilding Corp.
Charleston Dry Dock & Machine Co.
Consolidated Shipbuilding Corp.
Johnson Iron Works, Ltd.
Merchant Shipbuilding Corp.
New London Ship & Engine Co.
New York Shipbuilding Corp.
Standard Motor Construction Co.
Staten Island Shipbuilding Co.
Alex. Stephen & Sons, Ltd.
Sun Shipbuilding Co.
Todd Shipyards Corp.
Vulcan Iron Works, Inc.
Ward, Chas., Engineering Works

Shipbuilding Cranes
(See Cranes)

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Cox & Stevens
Ferris, Theodore
Haight, Edward S.
Maritime Engineering & Sales Corp.
McClelland, N. E., & Co., Inc.
Pommer, Walter E.
Watts, J. Murray

Ship Chandlers
Williams, Wm. E.

Ship Clocks
(See Clocks)

Ship Compositions
Wailes Dove - Hermiston Corp.

Ship Cowls
(See Cowls)

Ship Fittings, Supplies and Equipment
Griscom-Russell Co.
Williams, Wm. E.

Ship Glue
(See Marine Glue)

Ship Locks and Lathes
Tiebout, W. & J.
Williams, Wm. E.

Ship Plates
(See Steel Plates; also Zinc Ship and Boiler Plates)

Ship Repairs
(See Dry Docks and Marine Railways)

Ship Rivets
(See Rivets)

Ship Stores
(See Chandlery Stores)

Ship Stabilizers
Sperry Gyroscope Co.

Ship Telegraphs
Cory, Chas., & Son, Inc.

Ship Telephones
Cory, Chas., & Son, Inc.

Ship Timbers
(See Lumber)

Shipyards
(See Shipbuilders)

Shipyard Cranes
(See Cranes)

Shipyard Whirlers
(See Cranes)

Shop Cranes
(See Cranes)

Signalling Apparatus
Cory, Chas., & Son, Inc.

Sirens
American Steam Gage & Valve Mfg. Co.

Skylight Lifting Gear
Tiebout, W. & J.

Sleeves
(See Sockets and Sleeves)

Slitting Machines
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Niles-Bement-Pond Co.

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Crane Co.
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For instance, in a keg of ¾" x 2" Button Head rivets weighing 100# you will find 250 rivets fit to drive—not one will have to be scrapped on account of poor quality or workmanship.

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Continental Iron Works, The

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(See Rope and Wire Rope)

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Warren Steam Pump Co.

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Williams, Wm. E.

Zinc Plates
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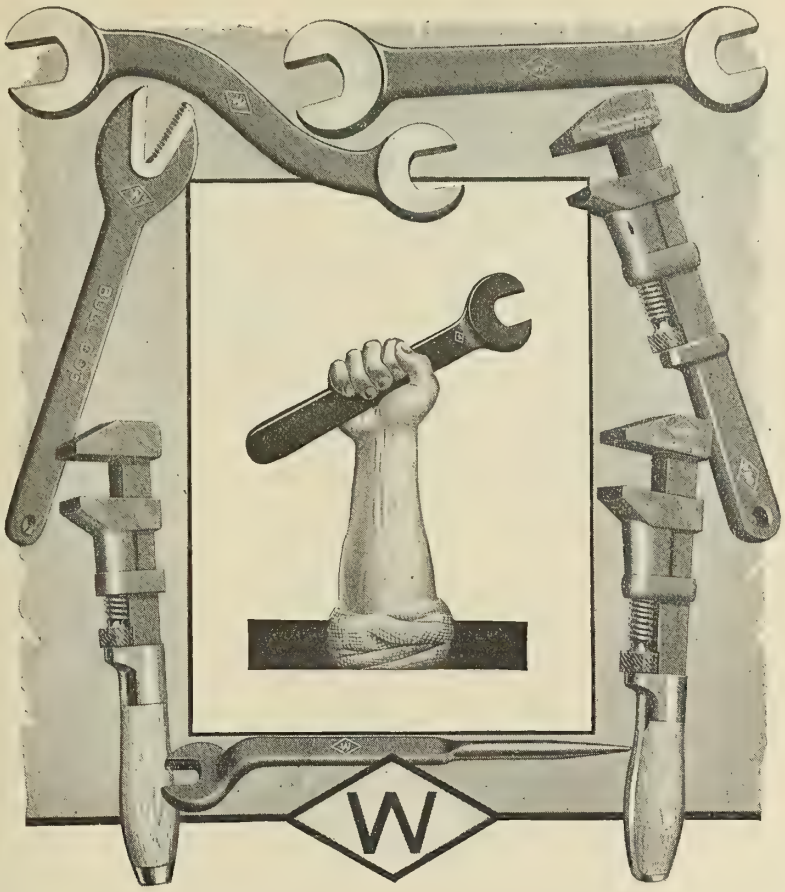
Williams, Wm. E.



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Concentrate your orders and save money, time and trouble by combination shipments. Wrench Book on request.

J. H. WILLIAMS & CO.

"The Wrench People"

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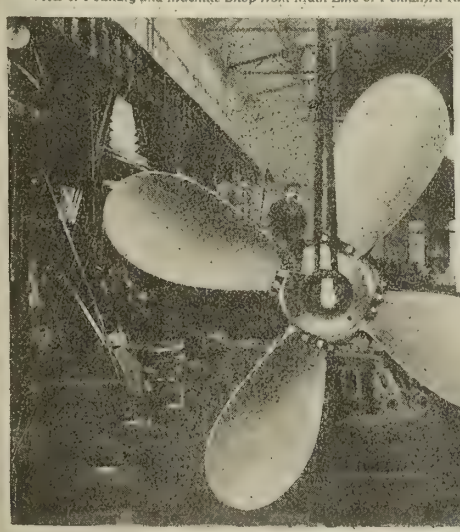
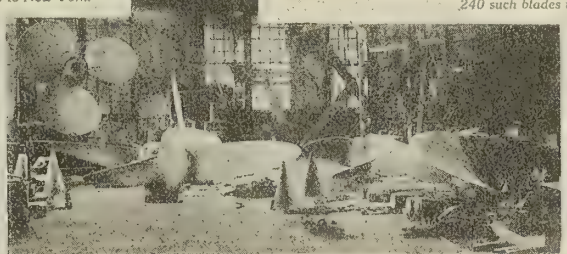
View of Foundry and Machine Shop from Main Line of Penna. R. R. to New York.

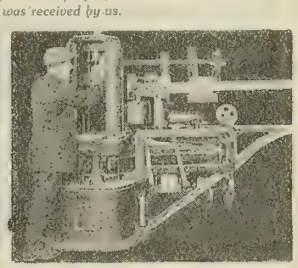
A few blades for an 18 ft. 6 in. diameter propeller. An order for 240 such blades was received by us.



Showing first propeller (on an order of 40) delivered to HOG ISLAND, for use on the class "B" ships building there. Diameter 18 ft. 6 in. Weight 34,000 lbs. Manufactured by American Manganese Bronze Co.

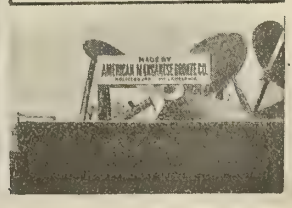


Interior of Main Foundry Bay.



View of our Tinius Olsen Testing Machine.

AMERICAN MANGANESE BRONZE COMPANY
HOLMESBURG, PHILA., PA.



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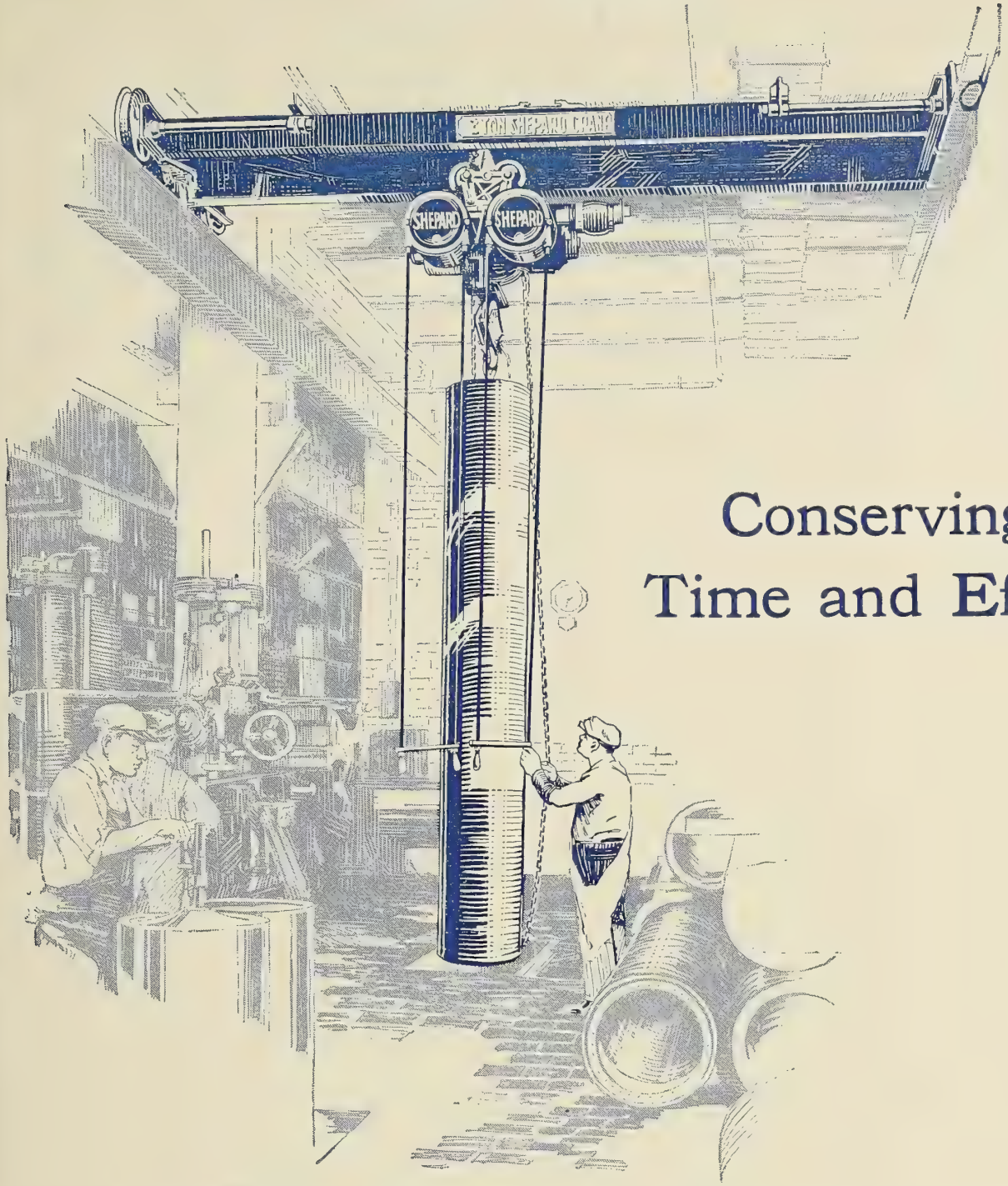

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ELESCO

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Japanese Ships are Superheated.
Dutch Ships are Superheated.
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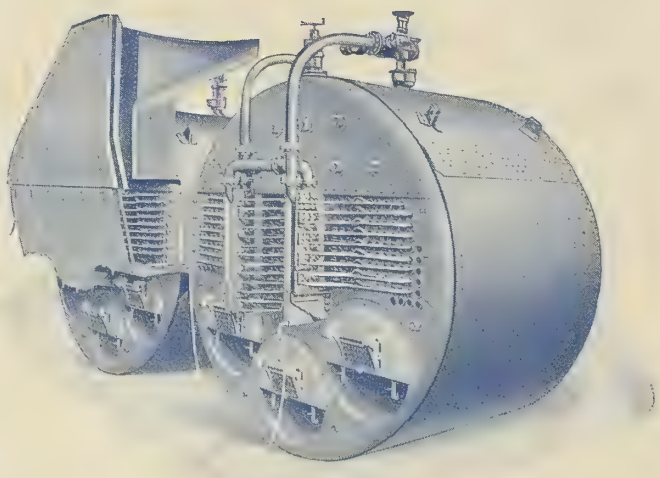

In Scotch boilers steam passes from the boiler, through the superheater located in the fire tubes of the boiler, thence to the engines or turbines. ELESCO Superheaters are readily accessible and easily cleaned.

Therefore, **American Ships** must be operated on high degree superheat to meet after-the-war competition successfully because high degree superheat means lower operating costs.

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AUGUST, 1921

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American Marine Week

THE Marine Equipment Association of America will hold an exposition the week of November 14th to 19th, inclusive, at the Central Mercantile Building, Sixth Avenue, 18th to 19th Streets, New York City.

The action of the Marine Equipment Association in deciding to exhibit during the week in which the Society of Naval Architects and Marine Engineers will hold its annual convention, and the appointment by the Council of that society of a committee consisting of Captain C. A. McAllister, Chairman, J. Howland Gardner, W. H. Todd, H. H. Raymond and F. L. DuBosque to act with a like committee of the Marine Equipment Association in laying out a joint program for a big "American Marine Week," will mean much to the shipbuilding industry of this country directly, and will also stimulate public interest in the American merchant marine. Also, the American Society of Marine Draftsmen has changed the date of its annual meeting to November, and it is believed that other organizations in the marine field will decide to meet during that week.

In order to keep pace with this event, MARINE ENGINEERING will publish special numbers for the months of November and December. The November issue will be distributed at the exposition, and the December number will contain a detailed report of the week together with the proceedings of the meetings held.

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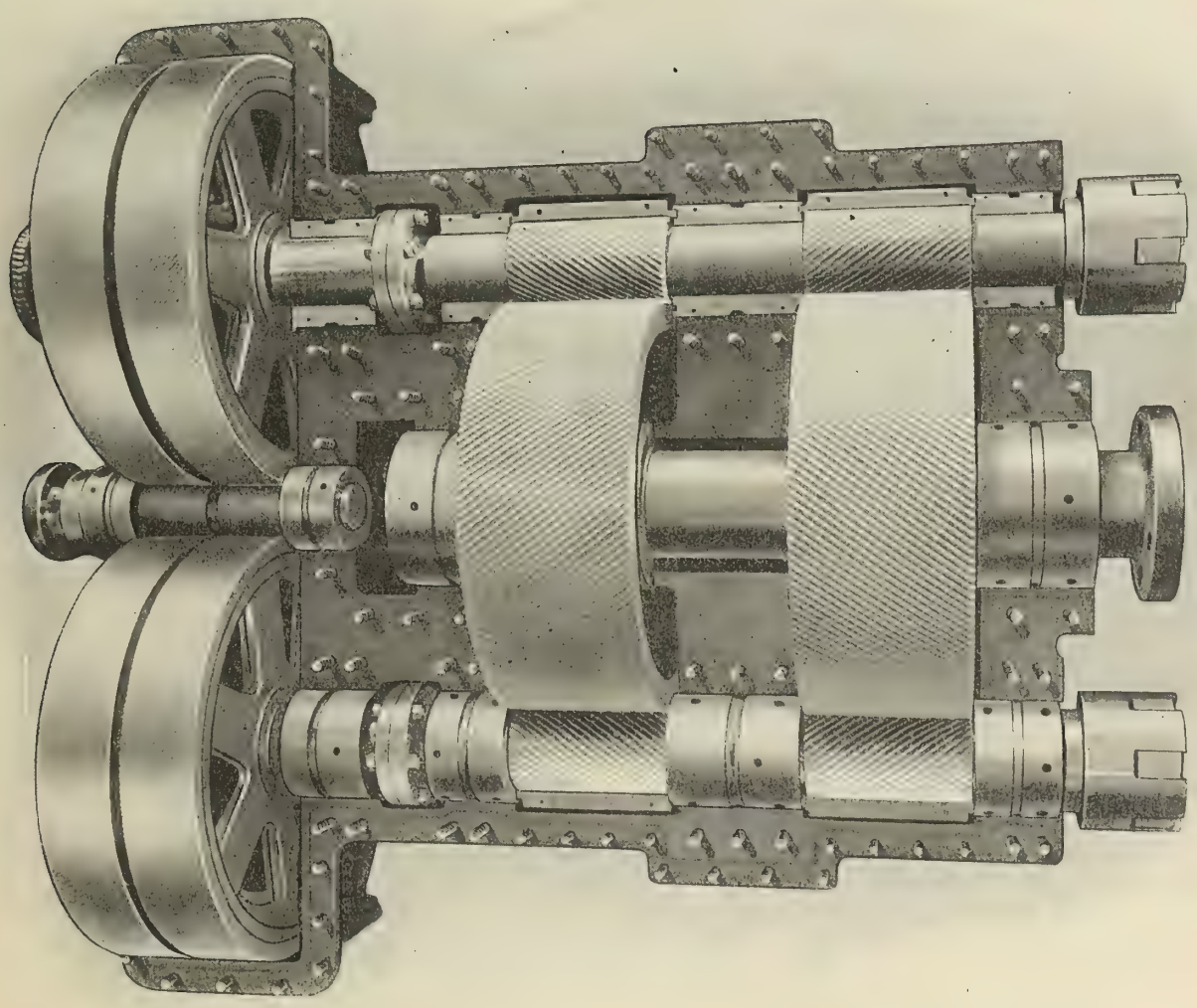

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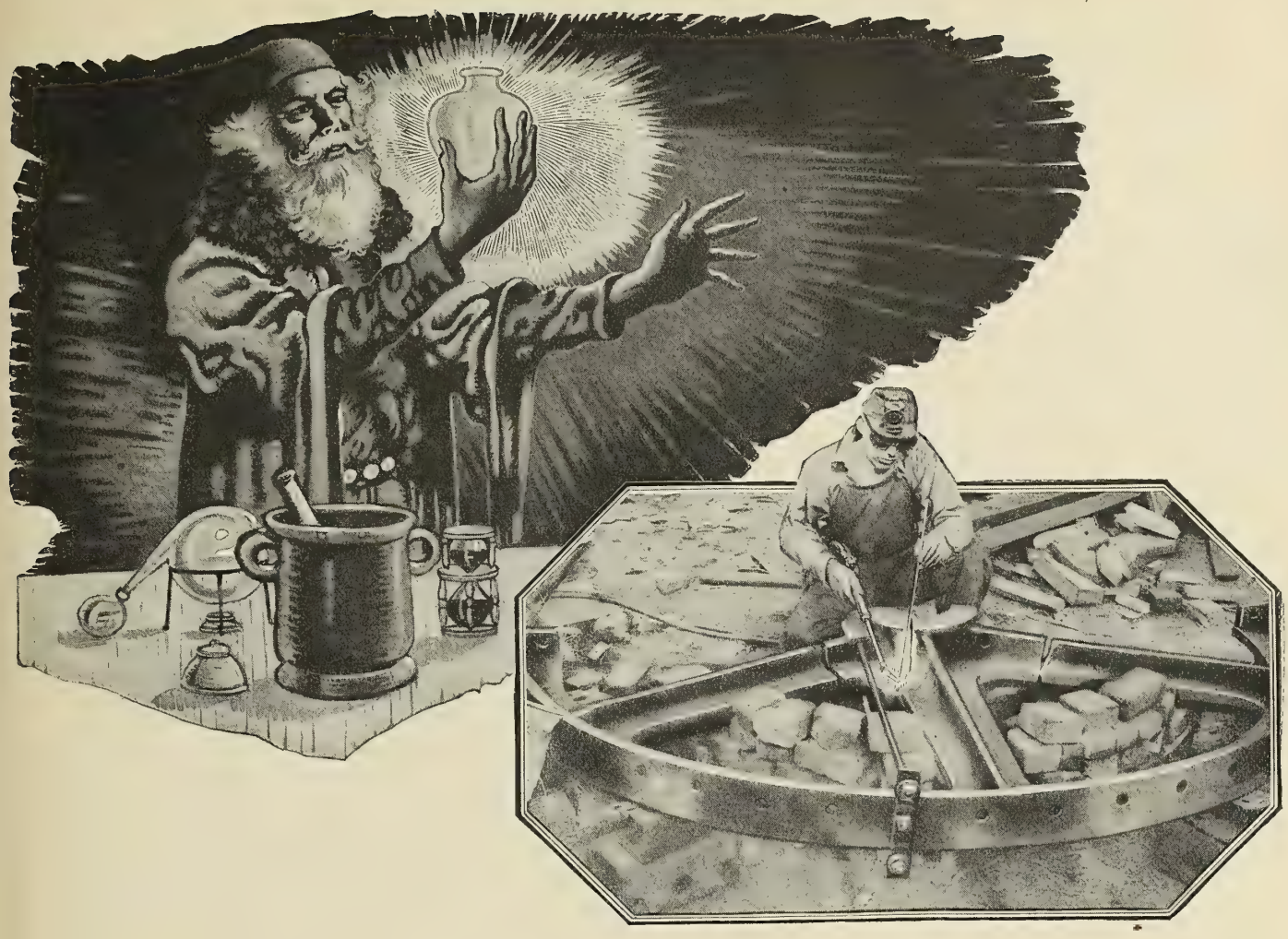

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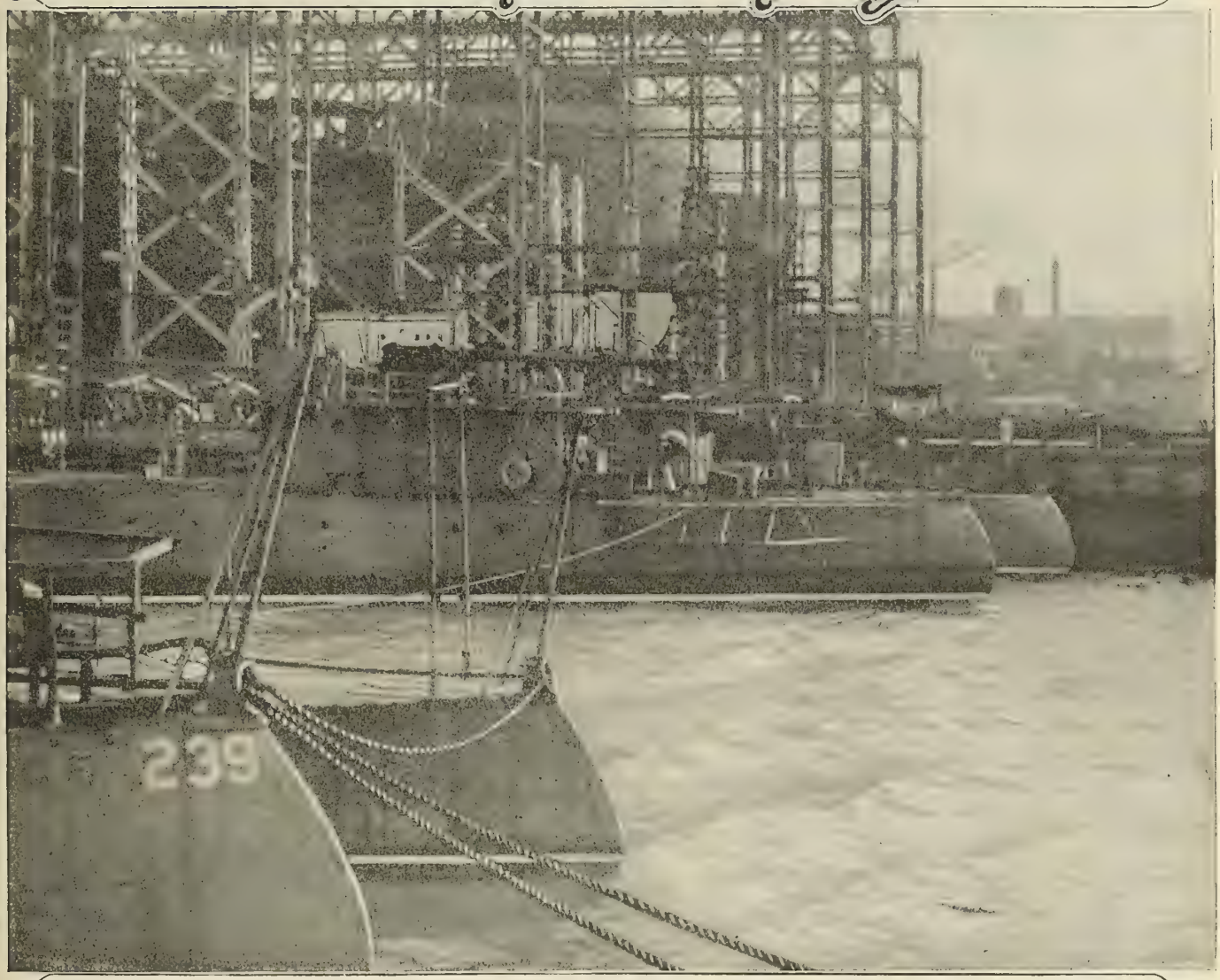

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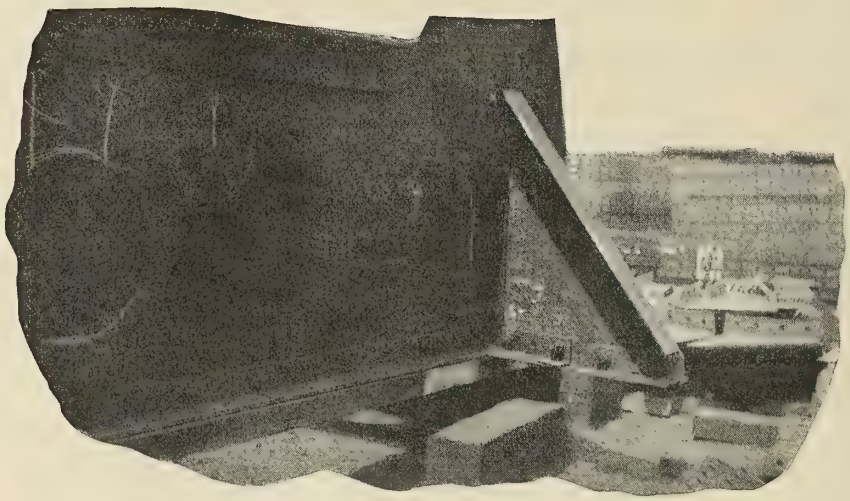

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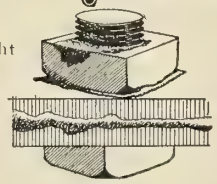

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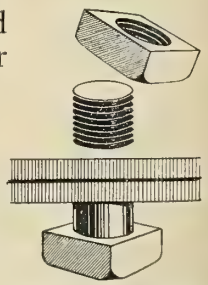

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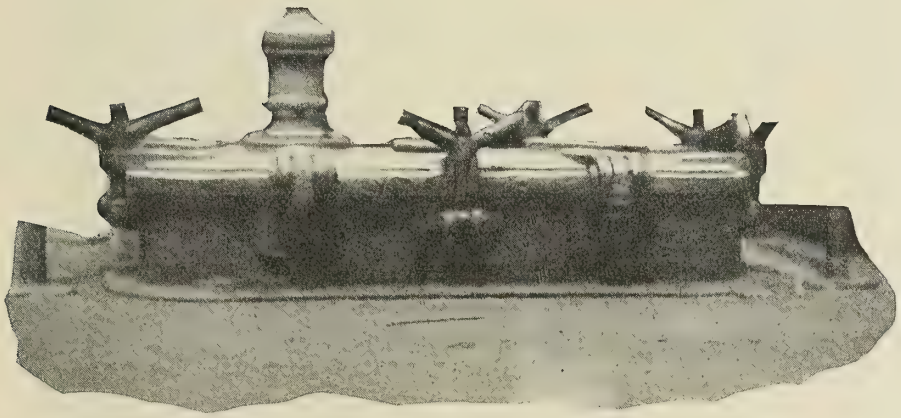

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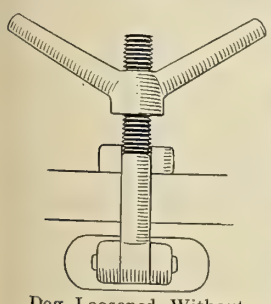

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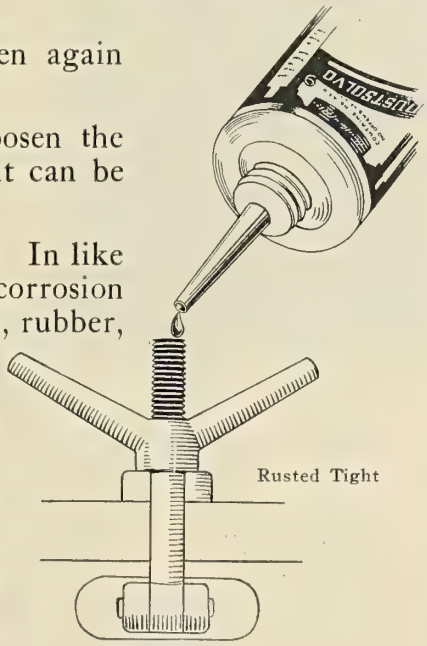

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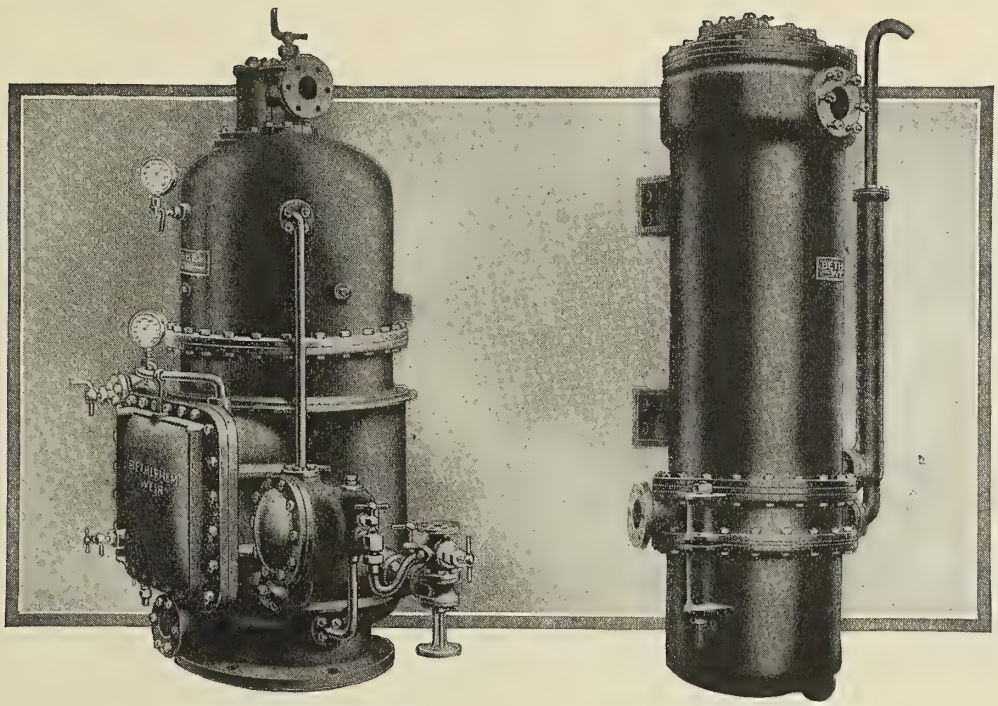

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Railroad Siding: Railroad siding connecting with Bush Stores and the D. L. & W. R. R.

All the dry docks are motor driven; air compressors and all other machinery are electrically equipped. In this immense store yard is a vast amount of repair material including 5,000 tons of plates and angles.

JAMES SHEWAN & SONS, Inc., is in a position to handle any size conversion or repair job.

JAMES SHEWAN & SONS, Inc.

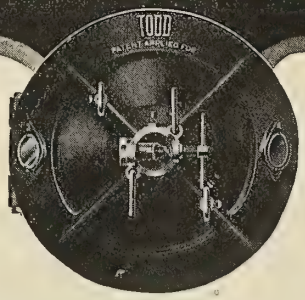
Over 50 Years of Continuous Operation

Brooklyn Yard
Ft. of 25th, 26th, 27th and 28th Streets

New York Office
32 Broadway

TODD-SYSTEMS-WHITE

MECHANICAL OIL BURNING



EFFICIENCY
SIMPLICITY

RELIABILITY
ECONOMY

TODD MECHANICAL OIL BURNER is the finished product of years of untiring experimentation and development in burning fuel oil mechanically.

700 INSTALLATIONS

On Vessels of the Leading Steamship Companies U. S. Shipping Board and U. S. Navy Including Many of the Largest and Most Powerful Steamships in the World

LET OUR EXPERTS ADVISE YOU. ESTIMATES FURNISHED

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MANUFACTURING AGENTS

SEATTLE AND NORTHWEST:	TODD DRY DOCKS, Inc.	HARBOR ISLAND, SEATTLE, WASH.
CANADA:	N. E. McCLELLAND & CO., Ltd.	MONTREAL

TODD · SHIPYARDS · CORPORATION
— PLANT OF —
WHITE FUEL OIL ENGINEERING CORP.
ENGINEERS 742 East 12th St., New York PARSONS TURBINES
TELEPHONE — DRY DOCK 2300

WORLD'S LARGEST SHIP-REPAIR ORGANIZATION

Plant of Tiejen & Lang Dry Dock Company, Hoboken, N. J.

SHIP BUILDERS
AND REPAIRERS
BOILER MAKERS
PARSONS TURBINES
OIL BURNING
INSTALLATIONS
ELECTRIC DRIVE
EQUIPMENT

NINETEEN
FLOATING DOCKS
TWO GRAVING DOCKS
TWELVE SHIPWAYS

PLANTS

Robins Dry Dock & Repair Company
Erie Basin, Brooklyn, N. Y.

Tietjen & Lang Dry Dock Company
Hoboken, N. J.

Tebo Yacht Basin Company
Foot of 23rd Street, Brooklyn, N. Y.

Clinton Dry Docks, Inc.
Foot of Clinton Street, Brooklyn, N. Y.

White Fuel Oil Engineering Corp.
Todd and White Oil Burning Systems
742 East 12th Street, New York City

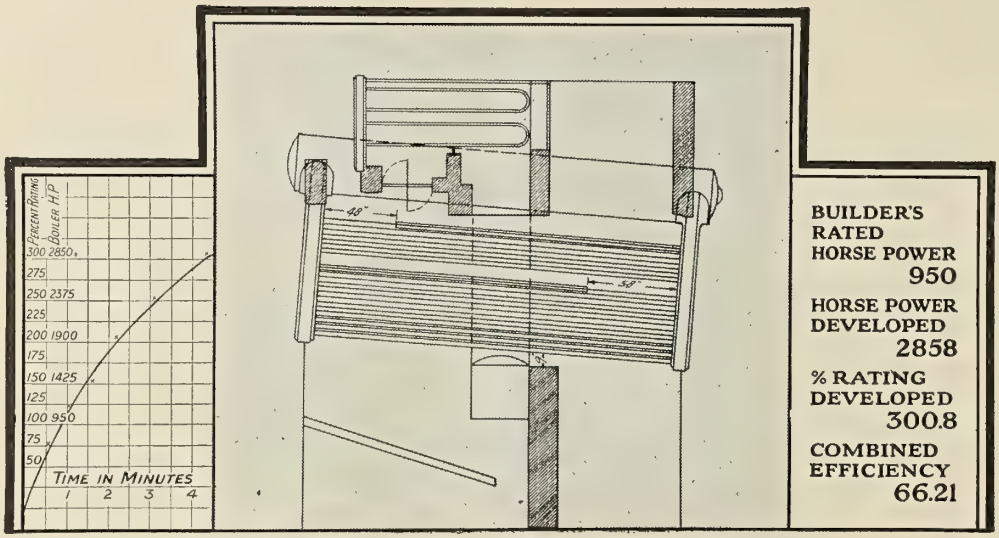
Todd Dry Dock & Construction Corp.
Tacoma, Washington

Todd Dry Docks, Inc.
Harbor Island, 16th Ave. S. W.,
Seattle, Wash.

TODD · SHIPYARDS · CORPORATION

CABLE "ROBIN" NEW YORK ALL CODES MAIN OFFICE 25 BROADWAY NEW YORK TELEPHONE BOWLING GREEN 6900

HELIOS



BUILDER'S RATED HORSE POWER 950

HORSE POWER DEVELOPED 2858

% RATING DEVELOPED 300.8

COMBINED EFFICIENCY 66.21

300% of Rating with a 950 H.P. Heine Large Unit Boiler

This performance was made in an official test conducted by George H. Perkins, Consulting Engineer, of Boston. There was no attempt to make a special showing, nor were the results made possible because of any favorable condition. In fact, the coal supplied was average low grade.

The percentage of rated load attained was limited only by the capacity of the stoker and the grade of coal used—evidence that actual working conditions prevailed.

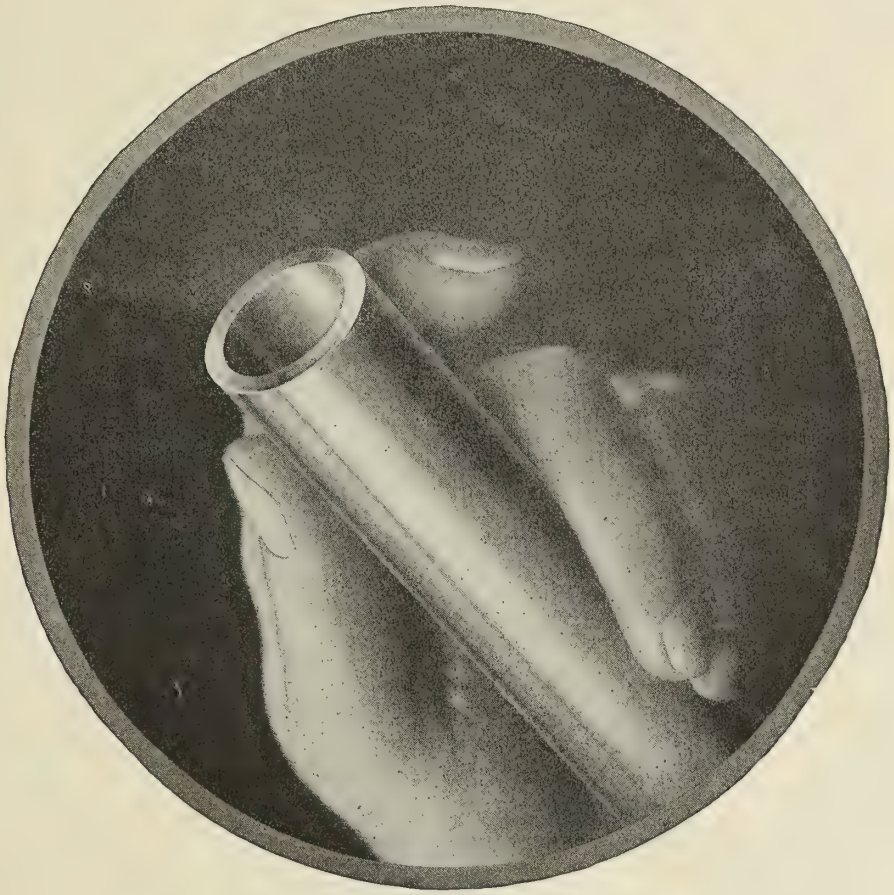
Among other things this test showed that the arrangement of baffling was approximately of the same efficiency at both high and low ratings.

Heine Safety Boiler Company, St. Louis, U. S. A.

2010

HEINE LARGE UNIT BOILERS

The Tube of Quality



Over a century of brass manufacturing coupled with our own process of tube making has enabled us to produce seamless tubing suitable for all varying uses. It is made of alloys best adapted for your special problem.

SCOVILL MANUFACTURING COMPANY

ESTABLISHED 1802.

WATERBURY, CONNECTICUT

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The Supreme Test of Rope

On many a hoisting winch the life of a rope is measured in hours and minutes. Rope can be put to no harder use. Whitlock All-Manila stands the test—it lasts longer. Therefore Whitlock is demanded by great steamship lines. A rope which meets these stern requirements will build business for any dealer whose trade requires first-class cordage.

WHITLOCK CORDAGE
THE UTMOST IN ROPE VALUE

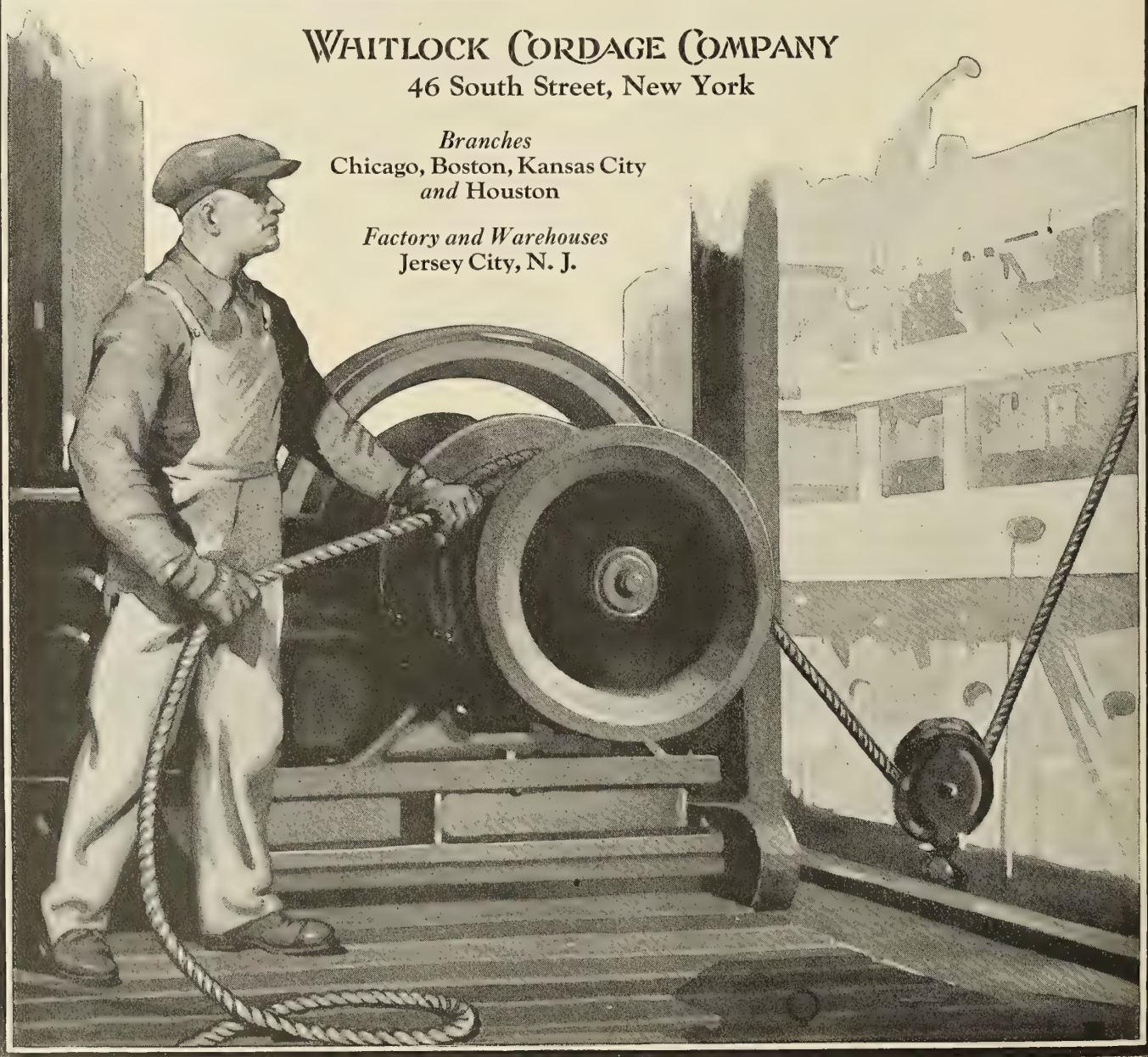
Whitlock All-Manila is the rope that is guaranteed superior to U. S. Bureau of Standards Specifications in every respect—quality of fibre, length per pound, strength. Sell a man Whitlock and he'll come back for more. It is the right rope for all-around work.

Write for the new Whitlock Catalog describing our complete line of Manila and Sisal cordage—the goods which will make more money for you. And ask for the Whitlock distributor in your territory.

WHITLOCK CORDAGE COMPANY
46 South Street, New York

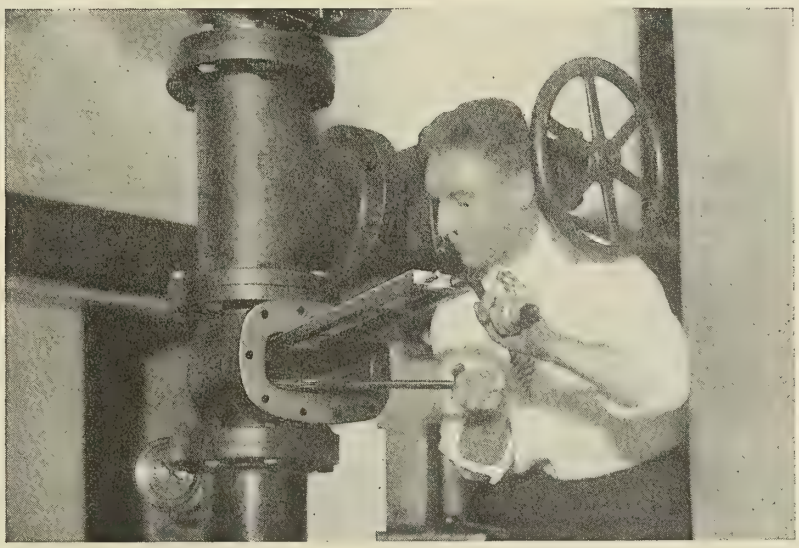
Branches
Chicago, Boston, Kansas City
and Houston

Factory and Warehouses
Jersey City, N. J.



Dexter Gate Valve Reseating Machine

Approved by United States Navy Department



One of these machines for reseating gate valves 1½″ to 16″ was delivered to the Commanding Officer of the U. S. S. Prometheus, repair ship of the Atlantic Fleet. The machine was tested and a favorable report returned to the Navy Department at Washington.

THE DEXTER GLOBE VALVE RESEATING MACHINE has been used by the Navy Department for thirty years.

Both of these machines are quickly attached to the valve body and an accurate seat is cut without removing the valve from the pipe line.

A few valves reseated saves the cost of the outfit, to say nothing of the power saved by making leaky valves tight.

Your Government uses them. Can you afford to be without one?

Write now for our new catalog—M-23.

THE LEAVITT MACHINE COMPANY

ORANGE, MASS., U. S. A.

Manufacturers of Dexter Globe, Gate and Pump Valve Reseating Machines

"WEW"

on

Marine Equipment

Spells Safety

Try Us For

Ship Supplies
and Equipment
Fire Extinguishers
Life Buoys

Life Preservers, Wire Rope Hawsers, Hoisting and Rigging Wires

We carry largest stock of ship supplies of all kinds

Send for Our illustrated catalog

We carry full line of "WEW" Bronze and Iron Body Valves—The "WEW" is the heaviest and best Marine Valve made

Immediate Deliveries made by Our Own Motor Trucks

WILLIAM E. WILLIAMS

62 FRONT STREET, NEW YORK

Specify

INCo Monel metal

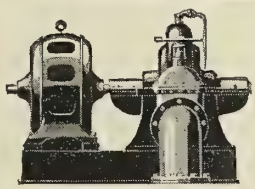
MAKE sure that "That Part" doesn't fail next time and cause another mid-week shut-down.

Where acids, alkalies and high pressure steam tend to destroy—specify Monel.

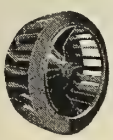
Where a part has failed, due to lack of strength, corrosion or rust—replace it with Monel.

Monel metal not only shows remarkable resistance to chemical attacks but has the structural strength and the same co-efficient of expansion as steel.

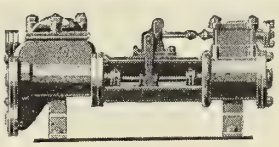
TURBINES—Monel blading and poppet valves are necessary for perfect turbine operation. At least the United States Navy thinksso. Monel is unaffected by high pressures and the eroding impact of superheated steam. *Make it of Monel.*



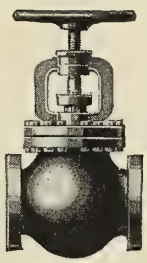
BLOWERS—If the blading of your blower is made of Monel, it will stand up under the corroding action of nearly all gases and dusts. Very few acids or alkalies affect Monel and it simply won't rust. *Make it of Monel.*



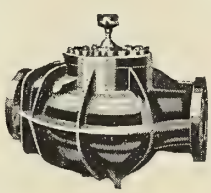
PUMPS See that Monel is used for liners, runners, valve seats, trim, hand hole covers, plunger rods, stuffing boxes and plungers. Strong as steel, uncorrodable and proof against superheat, it makes any pump the ideal toward which its designer worked. *Make it of Monel.*



VALVES—Use Monel for seats, rings, guide stems, clappers, wedges, spindles, dash pots and pistons. You are assured that none of the parts will fail under any conditions for which the valve was designed. Chapman, Crane, Jenkins, Lunkenheimer, Nelson, Walworth, Pratt & Cady and others use Monel in these parts. *Make it of Monel.*



METERS—Monel cylinders, bushing, valves, valve parts, spindles, screws, gear and wheels, assure the accurate and continuous work demanded of these instruments. *Make it of Monel.*



The name Monel identifies the natural nickel alloy—67% nickel, 28% copper and 5% other metals—produced by The International Nickel Company. Monel products include Monel blocks, Monel rods, Monel castings, Monel sheet, Monel wire, Monel strip stock, etc.

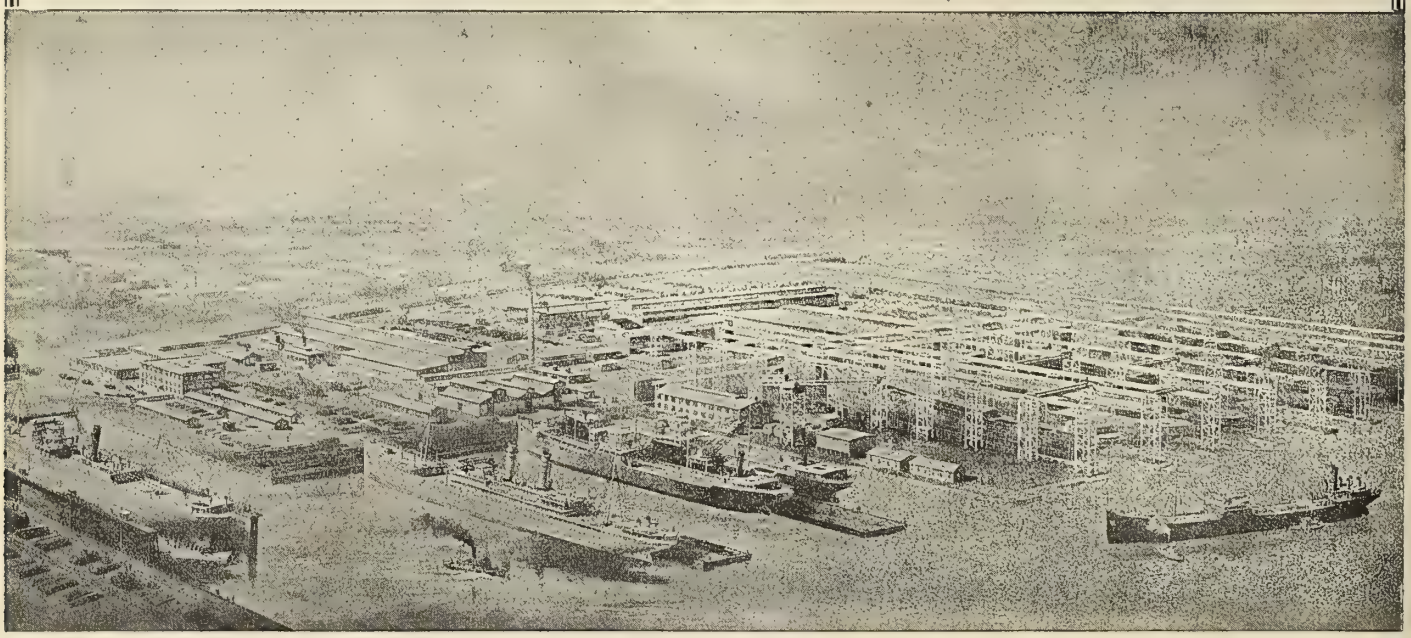
INCo MONEL METAL INCo NICKEL

THE INTERNATIONAL NICKEL COMPANY

67 Wall Street, New York City

Producers of Metallic Nickel in the forms of Ingot, Shot, Electrolytic Cathodes—99$\frac{8}{10}$%, Malleable Nickel, Nickel Salts, Oxides, Carbonates, Sulphates, Sulphides, Acetates, Formates, Monel Metal, Ingot, Shot, Blocks

Capacity of Shipyard—Eight Building Ways, Three Large Wet Docks



OUR NEW TEN THOUSAND TON FLOATING DRY DOCK NOW READY FOR BUSINESS!

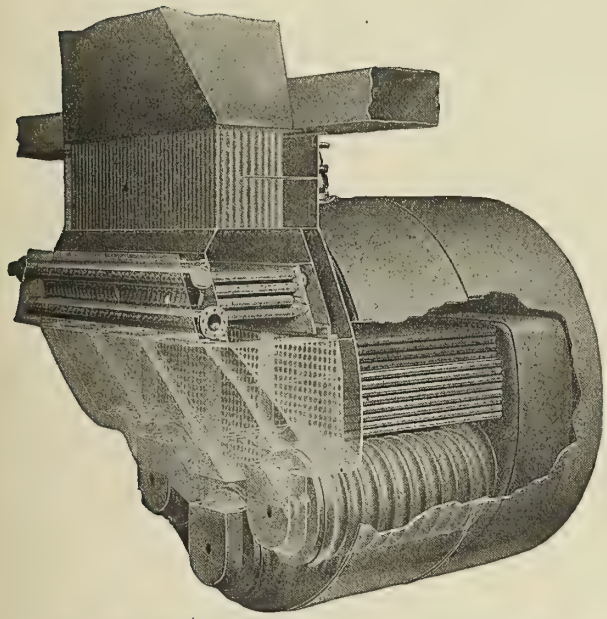
ENGINE BUILDERS — BOILER MAKERS—IRON FOUNDERS.
EXTENSIVE FACILITIES FOR SHIP, ENGINE AND BOILER REPAIRS.

BUILDERS OF HIGH CLASS SINGLE AND TWIN SCREW PASSENGER AND CARGO VESSELS, ALSO BULK OIL TANKERS, UP TO 600 FEET IN LENGTH

SUN SHIPBUILDING COMPANY

Main Office and Shipyard **Chester, Penna., U. S. A.**

How Foster Superheaters affect the economy of auxiliaries



Foster Superheater Installed in Uptake of Scotch Boiler

The auxiliary machinery on a modern ship will use from 15 to 25 per cent of the total steam generated. Practically all of this auxiliary equipment consists of simple cylinders, and the economy is quite poor, varying from 50 to over 200 pounds of steam per HP hour, depending upon the design of the equipment and the attention it receives.

The greater the steam consumption, the larger will be the saving effected by the use of superheat; therefore auxiliary machinery will show proportionately greater steam saving than is possible with the highly efficient main propelling engines or turbines.

At sea, moderately superheated steam used in all auxiliary machinery will save from 3 to 7 per cent of the total steam generated.

In port, moderately superheated steam effects an important economy. Owing to the extremely long steam line to deck winches, the moisture in the steam is very much greater than in any other type of equipment aboard ship. Recent experience has shown that in cases where two boilers had previously been necessary in port for operating winches, etc., the use of superheated steam enabled the operator to carry the load on one boiler. In tankers the use of superheated steam is particularly advantageous with cargo filling pumps.

With saturated steam, auxiliary equipment must operate with excessive moisture due to the long steam lines. With superheated steam, the elimination of this moisture not only produces a large steam saving, but also reduces the care, attention and repairs required.

44

POWER SPECIALTY COMPANY

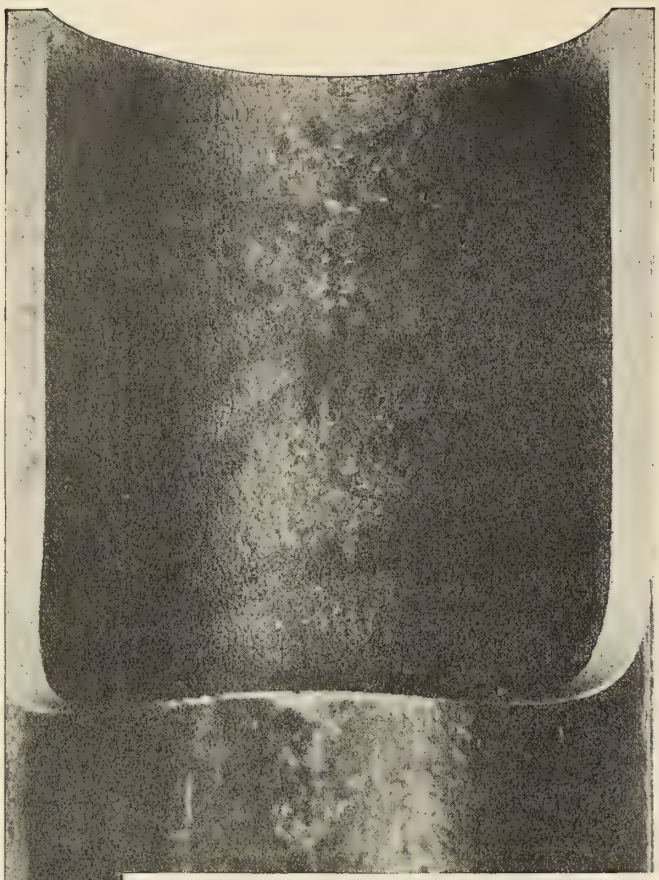
111 BROADWAY, NEW YORK

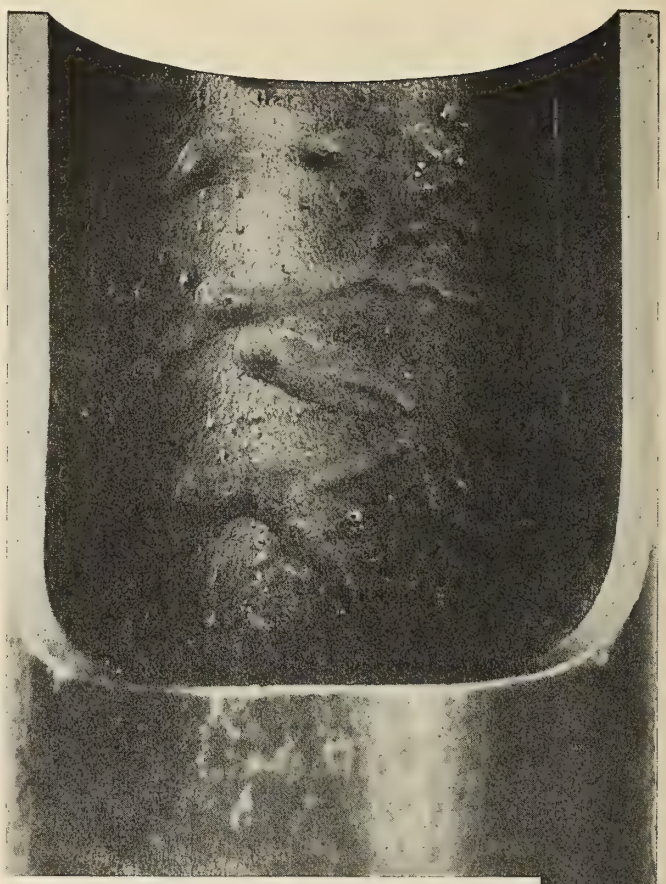
Branches: Boston, 50 Congress Street; Philadelphia, Land Title Building; Pittsburgh, Oliver Building; Chicago, Harris Trust Building; San Francisco, Balboa Building.

Agencies: Norfolk, T. J. Egan Co.; New Orleans, Marine Supply Company; Galveston, Neptune Ship Chandlery Company.

Works: Dansville, N. Y., and Egham, Eng.

FOSTER SUPERHEATERS





"The Same, yet Different!"

AND THE DIFFERENCE REPRESENTS IMPORTANT ADVANTAGES TO THOSE WHO SPECIFY OR USE BUTT-WELD PIPE. These two pieces of pipe are the same in size and material, but one is ordinary pipe (right, and the other (left) is **"NATIONAL"**

Welding SCALE FREE Pipe

Note the uneven scale patches on the one and the clean, smooth surfaces of the other. "NATIONAL" Welding-SCALE FREE Pipe (sizes ½ to 3-inch) is made by a special process which mechanically removes the heavy mill scale, or welding-scale; this means better galvanizing coating, reduction of corrosive tendencies, increased working capacity, freedom from troubles caused by loose scale, and other advantages of particular value in ship piping installations.

Ask for a copy of "NATIONAL" Bulletin No. 7

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

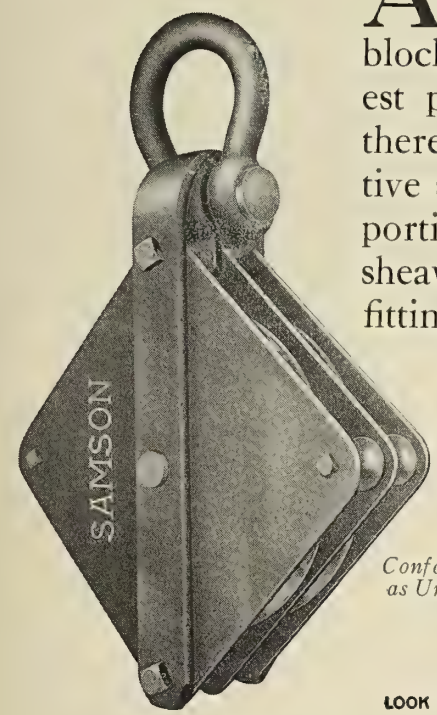
District Sales Offices in The Larger Cities

SAMSON

DIAMOND PATTERN WIRE ROPE BLOCKS

MIGHT MADE RIGHT

Mighty Because Rightly Built of the Right Materials

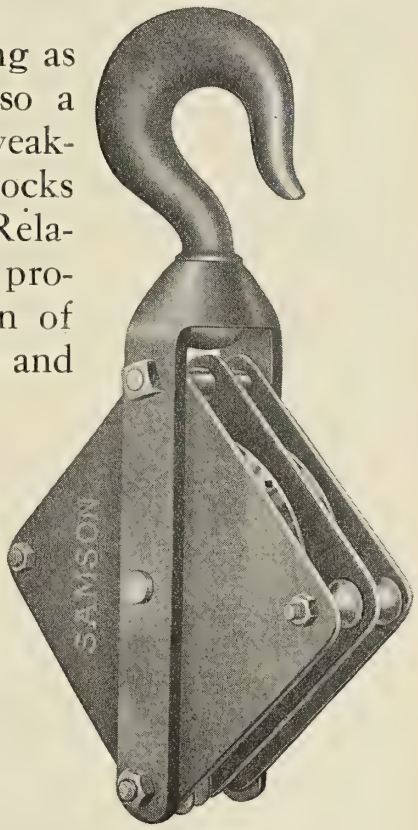


AS a chain is as strong as its weakest link, so a block is as strong as its weakest part. In Samson blocks there are no weak parts. Relative strength is correctly proportioned in construction of sheave pins, straps, plates and fittings.

Samson Blocks Withstand The Knocks

Conform to the same high standard as Union Quality Wood Tackle Blocks

LOOK FOR TORRINGTON U.S.A. UNION & HARDWARE CONN. THIS BRAND



WHERE OTHER BLOCKS REFUSE THE TASK SAMSON WILL PULL YOU THROUGH

UNION HARDWARE COMPANY

TORRINGTON, CONN.

NEW YORK OFFICE - 99 CHAMBERS ST.

The Lobsterman Knows that
Rope is something more than spun and twisted fibre.
For unless a real appreciation of the work the rope or twine must do governs the selection and preparation of the fibre, the rope itself will fail to give the greatest service.
Wherever lobsters are caught, it will be found that most of the traps are headed with Plymouth lobster twine, and as Plymouth Specialties are always preferred by those who know, so Plymouth Commercial Manila Rope gives a longer life of service than most buyers expect.
You will receive unexpected service if you demand for any rope-need Plymouth—THE ROPE YOU CAN TRUST.
PLYMOUTH CORDAGE CO.
North Plymouth, Mass.
Welland, Canada
5-51
PLYMOUTH
TRADE
MARK
1824
1921

POLLAK

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From the ladle analysis thru every subsequent operation,—each one is inspected and checked by our own inspectors.

Every "Pollak" forging is made for a given purpose and every "Pollak" forging serves faithfully and efficiently the purpose for which it was made.

THRUST SHAFTS, PROPELLER SHAFTS, CAM SHAFTS, ROTAR SHAFTS, CONNECTING RODS, PISTON RODS, ETC.

Forged-Machined, Hollow Bored, Heat Treated, Annealed; Plain carbon or Alloy steel.

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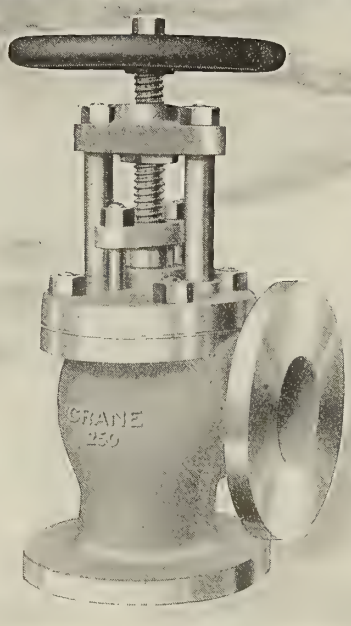
New York.

CRANE PLUMBING FOR SHIPS

VALVES FOR SHIPS



The Crane Line of

MARINE MATERIAL

includes all valves, fittings, specials, bends, etc. for ship use meeting the requirements of all inspection bureaus.

PLUMBING FIXTURES

of a dependable quality, both in service and appearance.

1855——CRANE CO.——1921

836 South Michigan Avenue Chicago

BRANCHES in 64 leading cities. WORKS—Chicago and Bridgeport.

CRESCENT BRAND SEAMLESS DRAWN CONDENSER TUBES

Seamless Drawn

CONDENSER TUBES

THE British Admiralty estimates that condenser tube failures are no greater than 50 in 1,000,000 per year—5/1000 of 1 per cent.

Yet marine engineers know that such small defects as a few pinholes or a split tube among the thousands of condenser tubes fitted in a vessel may be a serious embarrassment.

Crescent Brand condenser tubes are just the 5/1000 *of* 1 *per cent better than average condenser tubes needed to guarantee* 100 *per cent tube efficiency.* They are dependable.

That is because every step in the manufacture of Crescent Brand condenser tubes, from the selection of raw materials to the finished product, is part of a continual effort to produce a material that represents the highest standards of seamless drawn tubing.

Furnished in Muntz, Admiralty and other non-ferrous alloys; either plain or tinned.

Condenser tubes, evaporator tubes, distiller tubes, heater tubes, voice tubing, railings, brass and copper water and steam pipes.

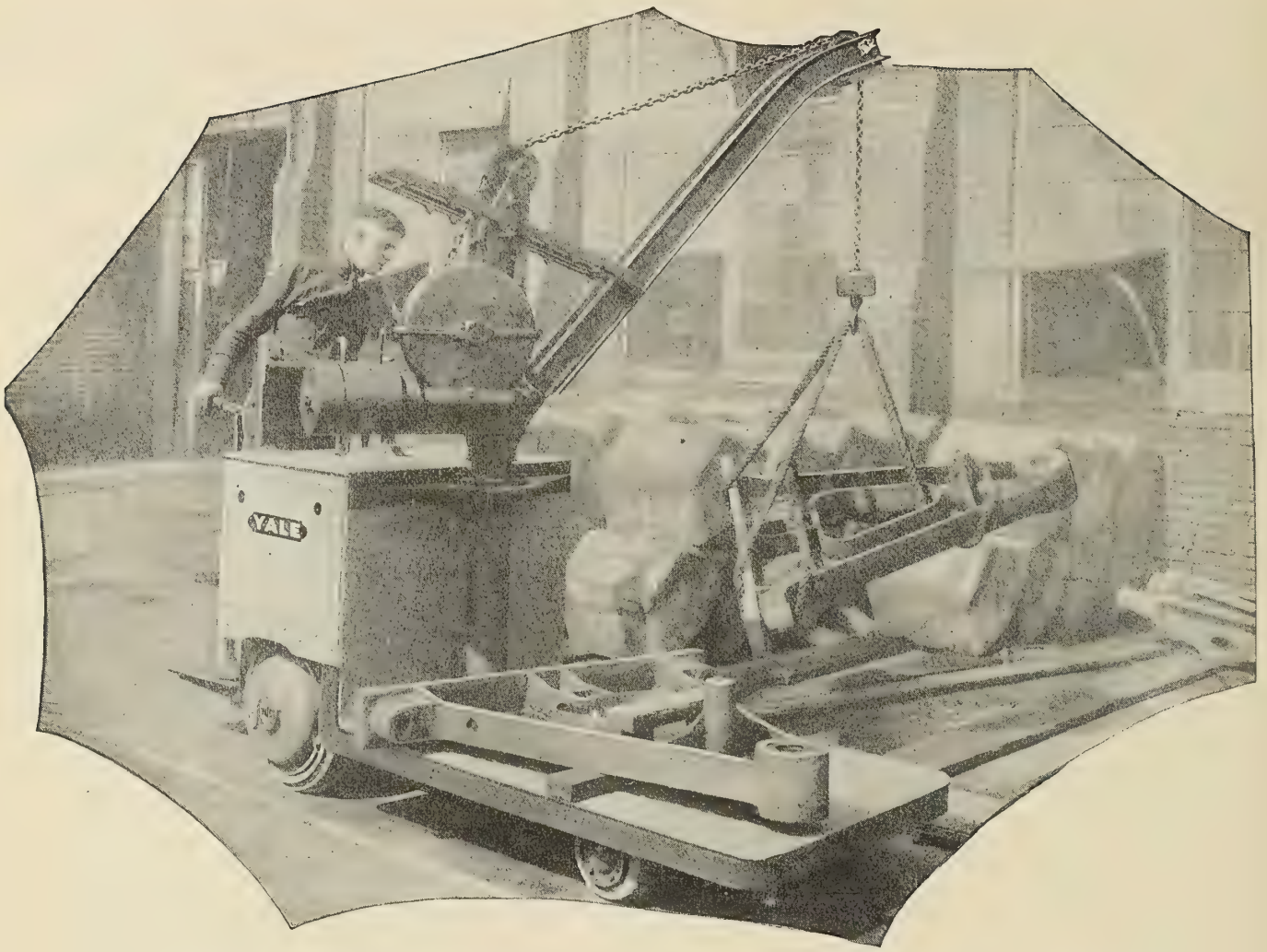
Prices on application.

WHEELER
CONDENSER & ENGINEERING CO.
CARTERET, N. J.

TUBES OF QUALITY

See our exhibit at the Seventh National Exposition of Chemical Industries, New York City, during the week beginning September 12.

No. 147



The Yale Way is a 1-Man Way

THE Yale DF-60 Crane Truck illustrated, enables one man to carry these heavy shaft hanger brackets from the rough storage yard into the machine shop, and to place them directly on the planer bed.

Consider the saving effected by this in both time and labor!

Careful studies recently made in a large manufacturing plant showed that each ton of finished products turned out required the equivalent of 258 tons of handling.

The Yale Way more than pays for itself the first year in the saving it effects in material handling costs.

We can tell you, for instance, how one Yale truck saved $60 per day hauling foundry sand; how in another plant a return of 344% on the investment was effected the first year; and numerous other instances of unusual savings.

Write today for facts about Yale Electric Industrial Trucks, Tractors and Trailers, Chain Blocks, Electric Hoists, and Trolley Systems.

Yale Made is Yale Marked

The Yale & Towne Mfg. Co.

Makers of Yale Products: Locks, Hoists and Electric Industrial Trucks

Stamford, Conn.

TRADE YALE MARK **Hoisting and Conveying Systems**

Necessity's Understudy

USERS deserve equal credit with our Service Engineers for the constant development of new uses for Boyer Riveting Hammers and Little Giant Air and Electric Drills.

In one, two, three order, three typical uses developed through their close co-operation are—

A Boyer Riveting Hammer driving drift bolts with *one* man on a two-man job. This is proof of two things: labor-saving adaptability of the tool and ingenuity in applying it, both made possible by the *powerful* Boyer stroke.

A Little Giant Portable Electric Track Drill drilling truck chassis. Supplies its own "old man," and works *six* times as fast as the portable drill it replaced, with one man less.

A Little Giant Portable Electric Drill mounted on a buggy. Almost as fast as this man can raise and lower the buggy handles, this Little Giant countersinks—an average of *9½ holes a minute.* Think of it!

Conclusion: If Necessity is the Mother of Invention, C-P Engineers are her Understudy, working first-hand with users and constantly widening the already wide utility of C-P labor-saving tools. Ask for bulletins.

Chicago Pneumatic Tool Company

Chicago Pneumatic Building · 6 East 44th Street · New York

*Sales and *Service Branches all over the World*

*Birmingham	*Chicago	*Detroit	Franklin	*Los Angeles	*New York	Richmond	*Seattle	Basle	Brussels	Copenhagen	Helsingfors	*London	Montevideo	Paris	Santiago	Shanghai	Toronto
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J-29

BOYER PNEUMATIC HAMMERS··LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS··VACUUM PUMPS··PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES ROCK DRILLS ·· COAL DRILLS

CHICAGO PNEUMATIC

Depend upon that Name

—LESS TAPS—
MORE HOLES PER TAP
WHEN
BRUBAKERS
ARE USED

BRUBAKER quality is not a matter of chance—it is a scientific certainty, every time.

Special machinery insures accurate pitch and correct relief. Improved methods of heat treating mean uniform and serviceable temper.

Then thorough inspection practically eliminates the possibility of defective taps getting into stock.

That's why Brubaker Taps tap 20% more holes per tap—cut faster and cleaner than the average tap. Your next requisition specify "Brubaker."

W. L. BRUBAKER & BROS. CO.
50 CHURCH STREET NEW YORK

Factory at Millersburg, Pa.

Did You Ever Pay Demurrage

because your telemotor or steering gear or some other auxiliary couldn't be overhauled in time to sail?

IT ISN'T NECESSARY

We specialize in prompt and efficient service.

Prompt means on time.

Efficient means correct parts and correct workmanship.

Have you tried our service lately?

Note: You may not need us now, but getting acquainted now will smooth the way when you're in a hurry. Give us a chance to explain.

American Engineering Company
PHILADELPHIA

New York
New Orleans

Cleveland
Boston
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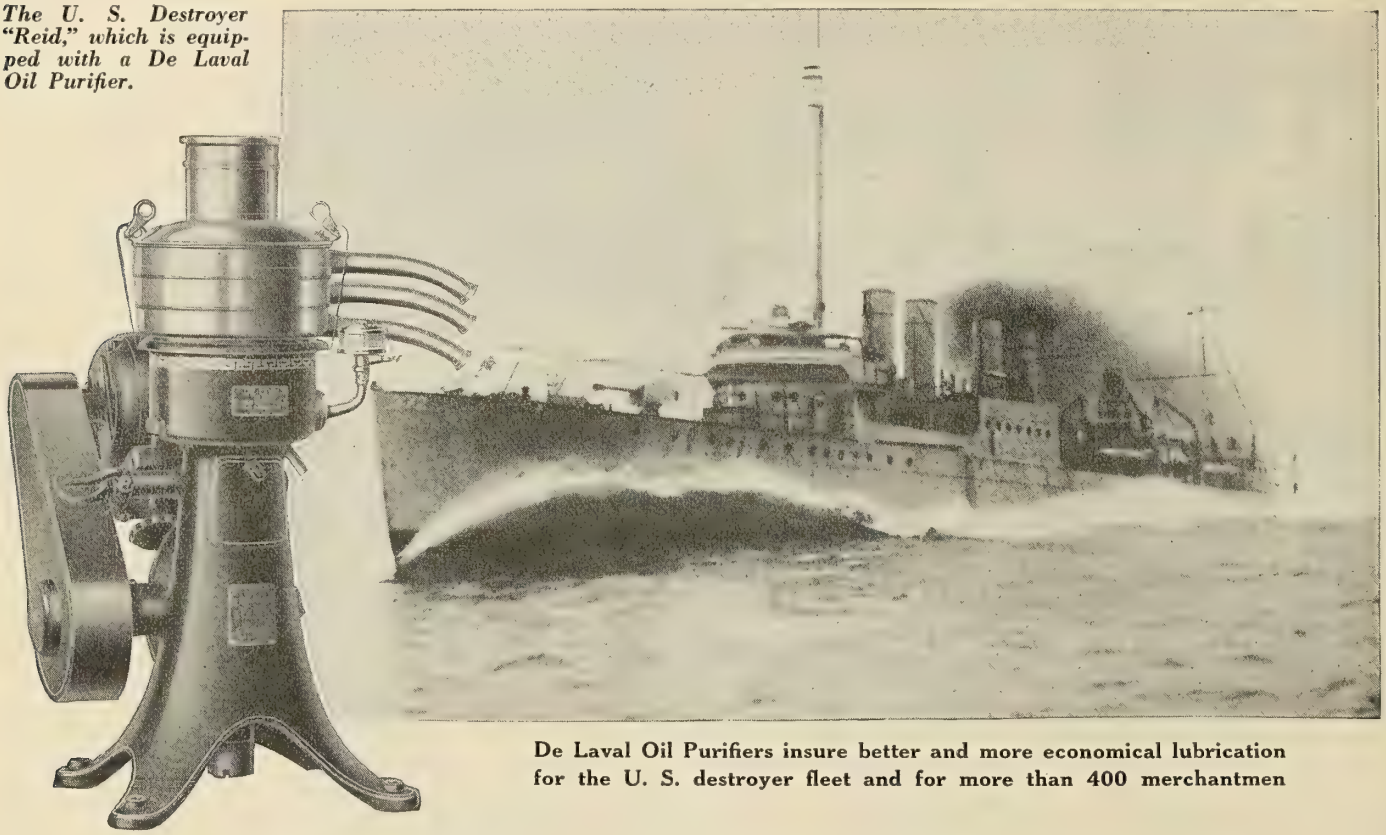
San Francisco
Vancouver, B. C.

The U. S. Destroyer "Reid," which is equipped with a De Laval Oil Purifier.



De Laval Oil Purifiers insure better and more economical lubrication for the U. S. destroyer fleet and for more than 400 merchantmen

"Full speed ahead" calls for the most perfect lubrication obtainable

—not only on the fast destroyer, but on the slower merchantman as well. Turbine bearings and reduction gears fairly eat up oil, and if there is water or dirt present in the lubricating system—well, you know what happens then.

Scored and burned out bearings and undue wear on gears can be avoided on your ship by installing a De Laval Oil Purifier. It keeps clean oil in your lubricating system all the time. Sludge and emulsions become only memories, as does the fact that you used to pump oil overboard after a short period of use.

The oil you save and the longer service you get from machinery combine to pay the cost of installing a De Laval—usually in a few months.

Bulletin 103-E covers the steam field. Bulletin 102-E describes the application of De Laval Purifiers in handling crank-case oils. Write for the one in which you are interested.

The De Laval Separator Company

New York, 165 Broadway **Chicago, 29 East Madison St.**

Manufacturers' Selling Agents

De Laval Steam Turbine Company
Trenton, N. J.

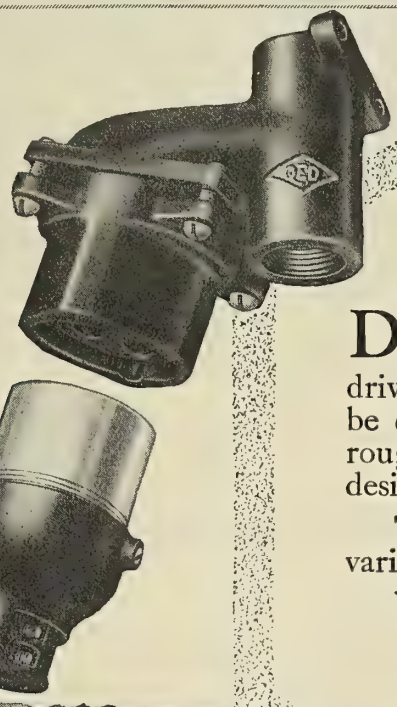
De Laval Pacific Company
San Francisco, Cal.

Chadburn's (Ship) Telegraph Company, Ltd., Cyprus Road, Bootle, Liverpool
Turbine Equipment Company, Toronto, Ontario, Canada

Sooner or later you will use a De Laval

CONDULETS

QE SERIES CONDULETS
are inclined away from the wall which makes insertion and removal of plugs easy.



"Lettering on illustration indicates type of Condulets."

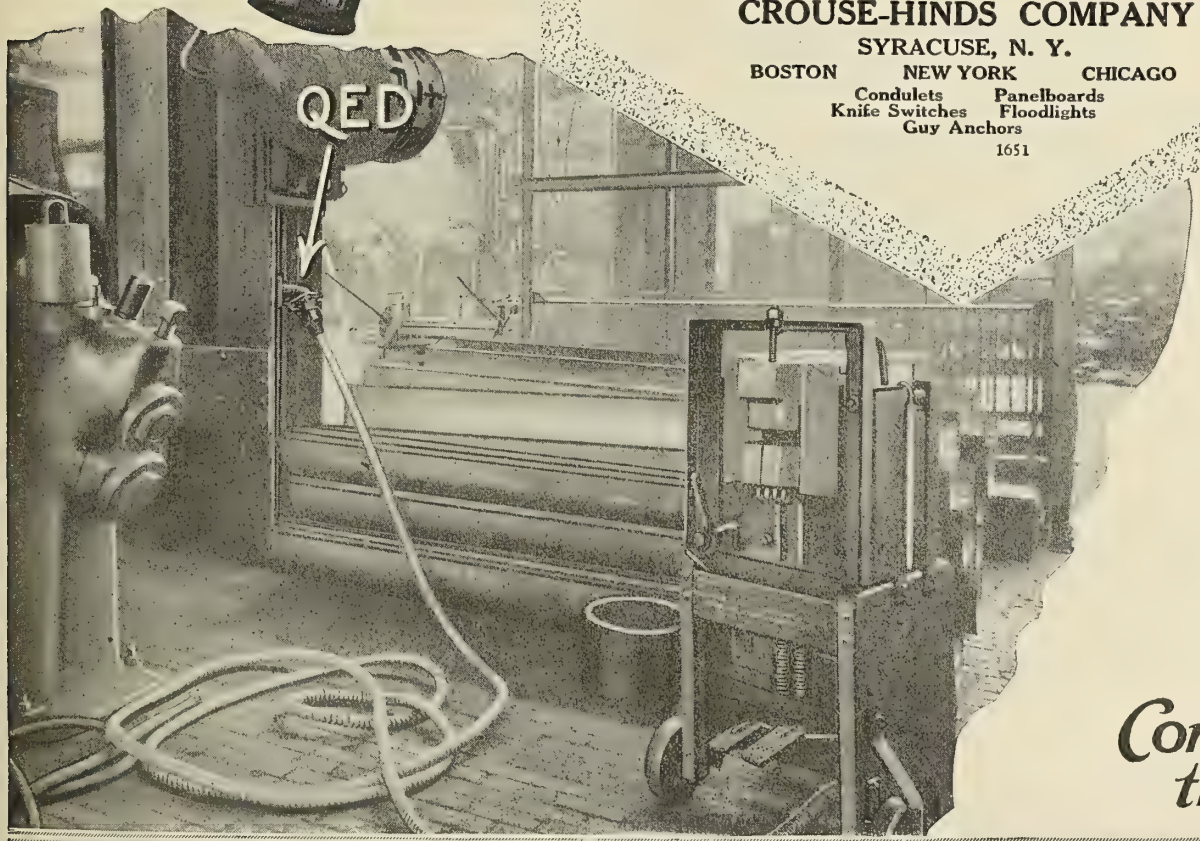
Heavy Duty Plug Receptacles

DEPENDABLE plugs and receptacles are necessary parts of all electrically driven portable tools and appliances. To be dependable they must be able to stand rough usage. QE series Condulets are designed for heavy duty service.

These Condulets and plugs are made in various styles and capacities.

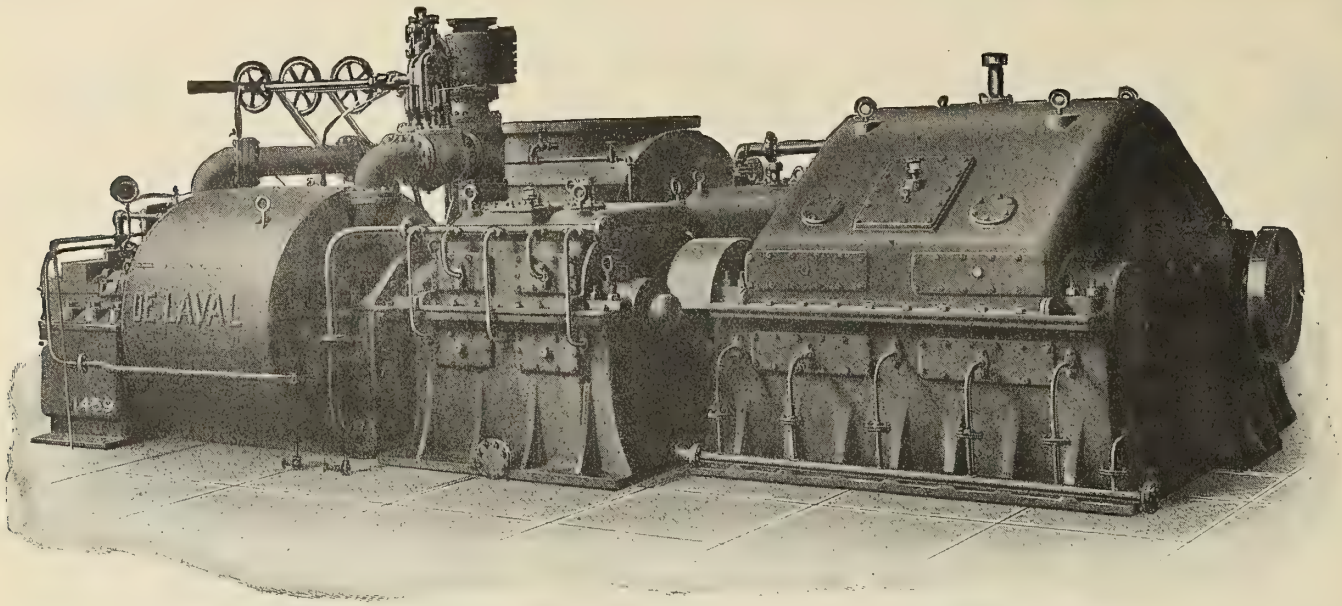
Write for Condulet Catalog.

CROUSE-HINDS COMPANY
SYRACUSE, N. Y.
BOSTON NEW YORK CHICAGO
Condulets Panelboards
Knife Switches Floodlights
Guy Anchors
1651



Condulet the Job

CROUSE-HINDS



De Laval 3300 hp. compound turbine, with double reduction gear; propeller speed 90 r. p. m.

An Efficient Compound Turbine
and
A Reliable Gear

The use of the double-reduction gear in De Laval units, of which one especially designed for tanker service is shown herewith, permits of the best turbine speed for efficiency, while the division of the turbine into high-pressure and low-pressure sections is conducive to low steam consumption and greater flexibility of control. Either section of the turbine can be operated alone upon high-pressure steam from the main throttle control, in case of accident.

Our Catalog M46 describes and illustrates the several types and sizes of De Laval geared turbines for marine use.

Reversing elements are located in the high and low pressure sections, and an interlocking valve gear provides against admission of steam to the ahead and reverse turbines at the same time.

The speed reducing gears embody those elements which our long experience in the production of such gears has shown to be essential to reliable, continuous operation. The marked absence of noise indicates their excellence and good wearing qualities. A large number of De Laval gears have each run over 200,000 miles.

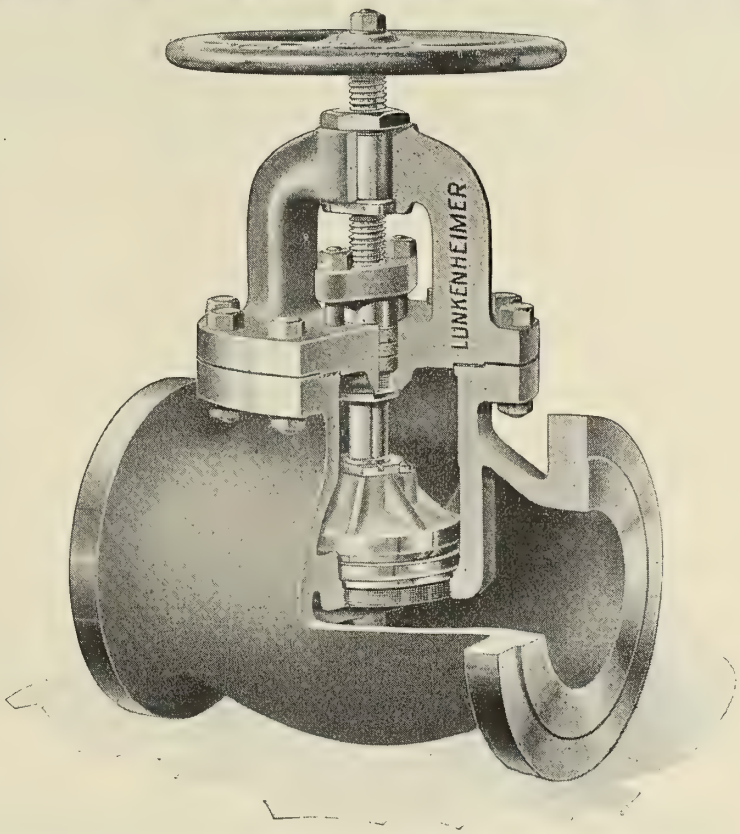
These facts explain why many shipowners, after experimenting with various kinds of gears, are now installing De Laval gears exclusively.

De Laval
Steam Turbine Co.
TRENTON, N. J.

163

LUNKENHEIMER

Globe, Angle, Cross and Check Valves



Maximum service with negligible cost of upkeep is the performance record of LUNKENHEIMER Iron Body Valves, and has led to their adoption as "standard equipment" on steam vessels.

Correct design, LUNKENHEIMER materials and the LUNKENHEIMER method of manufacture are the basic factors which determine their success, and the high degree to which these factors are combined is demonstrated by the exceptional results obtained by users in every class of service.

The broad scope of the LUNKENHEIMER line, embracing valves for 125, 175 and 250 pounds working steam pressure, covers every valve requirement.

LUNKENHEIMER distributors, situated in practically every port, carry stock for immediate delivery. Specify LUNKENHEIMER IRON BODY VALVES and insist on their installation.

THE LUNKENHEIMER CO.

"QUALITY"

Largest Manufacturers of
High Grade Engineering Specialties
in the World.

New York Chicago CINCINNATI Boston London

Export Dept., 129-135 Lafayette St., New York

13-17M-25

CURRENT EDITION
OF CATALOG BEARS
No 58
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LUNKENHEIMER
DISTRIBUTORS

Expediting Work on Large and Irregular Pieces

(Example No. 2)

Reducing the time of set-up and making it easy to drill and face many sided pieces quickly, is a sure way to reduce your shop costs. The accuracy of the graduations on P & H turntables insure precise results.

A piece like the 3000-pound frame shown below is set up on a 6-foot turntable by one man in 18 minutes or less, where P & H Equipment is used. The drilling of this frame is then completed from all angles with but the single set-up described above.

Now is a good time to look into your shop methods and arrange for means of doing things faster and at a lower labor cost.

Our Bulletin 214 and other information that may be of assistance to you, are yours for the asking.

Machine Tool Division

PAWLING & HARNISCHFEGER CO.

Milwaukee, Wisconsin

DALE MACHINERY CO., Inc.

New York: 54-60 Lafayette St. **Chicago: 541 W. Washington Blvd.**

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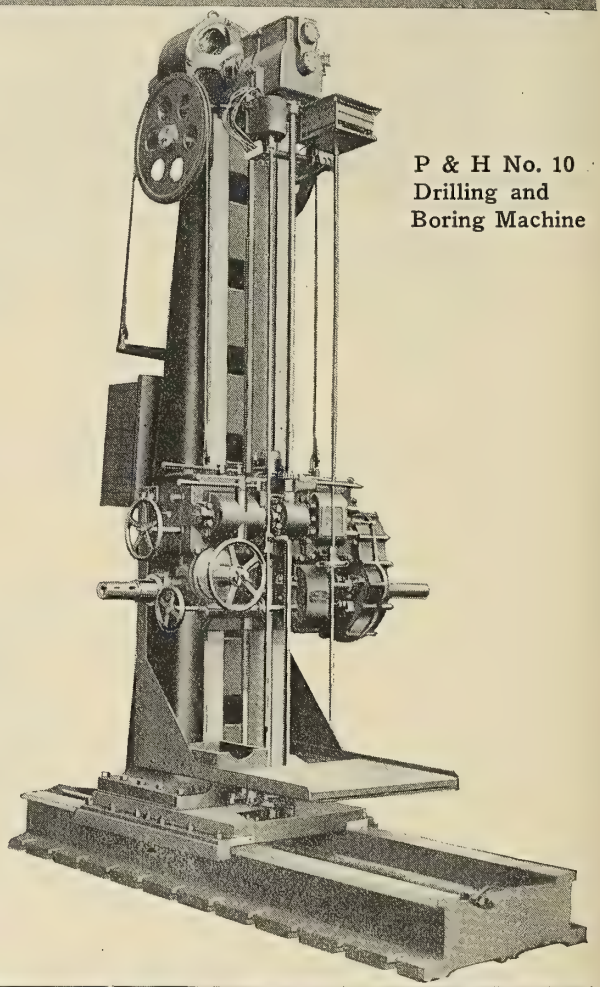
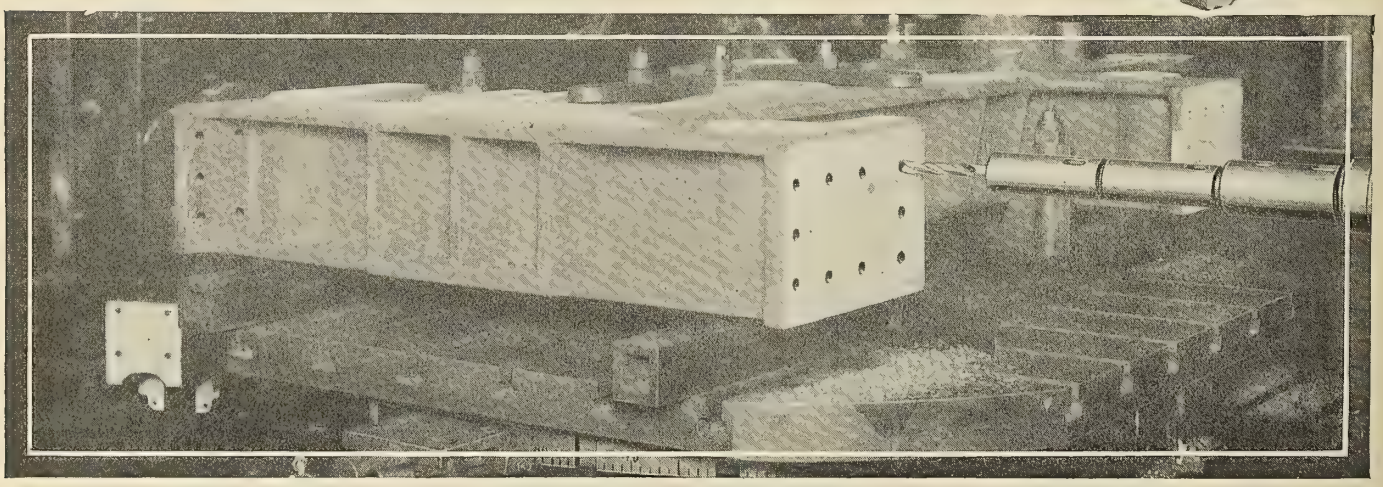
Birmingham: **C. B. Davis Engineering Co.**, Brown Marx Bldg.
Salt Lake City and Denver: **Landes & Co.**

P. & H. Branch Offices: San Francisco, Los Angeles, Portland, Seattle and New Orleans

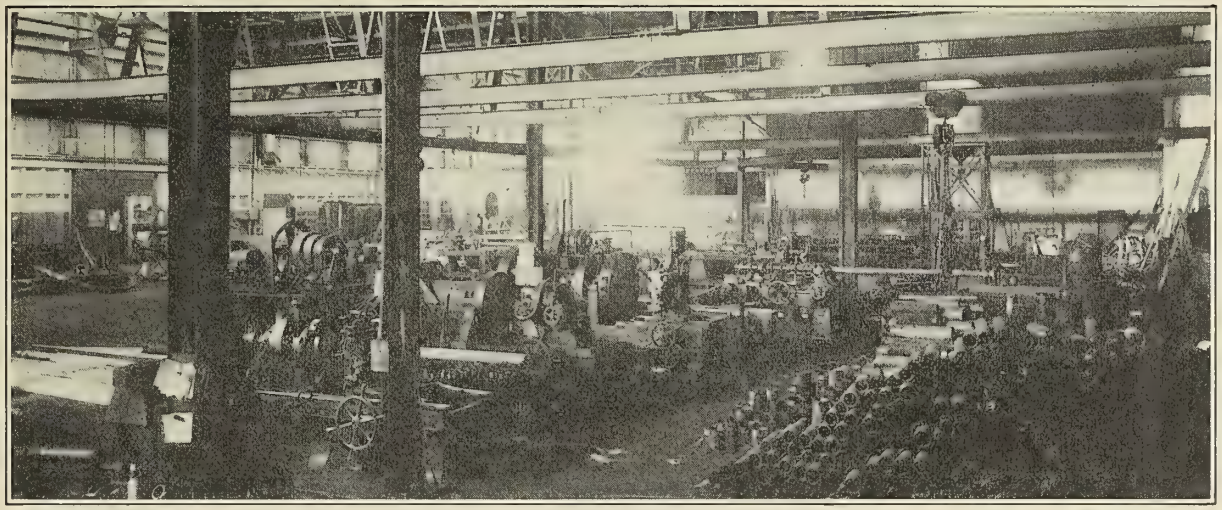


P & H No. 10 Drilling and Boring Machine



P&H HORIZONTAL DRILLING & BORING MACHINES

THE SHIPYARD WITH A TRADITION—FOUNDED IN 1859



Steel Pipe and Coppersmith Shop, Merchant Yard, Chester, Pa.

Merchant Steel Plus Merchant Experience

EXPERIENCE invites confidence. Long years of experience in fabricating heavy structural steel are to the credit of our Chester Yard.

Buyers of heavy structural steel will discover that the Merchant organization does more than just fabricate to specification. They will discover the merits of Merchant quality, service, price and delivery.

The services of our expert technical staff are at the disposal of those contemplating shipbuilding, engineering, or steel construction work.

Our Quotations will interest you

MERCHANT
SHIPBUILDING CORPORATION

Chester, Pa., or 39 Broadway, New York

Ask us to bid on the following:

Ship Construction

Designs ready for Tankers of 10,000 D. W. T. All kinds of ships up to 15,000 D. W. T. Motorships 11,500 D. W. T. with Diesel Engines. Conversion of Steamships to Diesel Motorships with Direct or Electric Drive. Repairs and Reconditioning of Ships.

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All kinds of Joiner and Cabinet Work.

Ingersoll-Rand

The Regulation of Class "PRE" Compressors

There is no place where the compressor's regulation is of greater importance than on constant speed, direct-connected motor driven units. Such machines necessarily operate at constant speed, and the successful performance of the motor, as well as the power consumed at various loads, depends upon the method of unloading.

Not only do Ingersoll-Rand Class "PRE" compressors operate at maximum full load efficiency, but their patented 5-step Clearance Control assures unusual efficiencies at ¾, ½, ¼ and no loads.

There are many other "PRE" features which will be of interest if you are considering the installation of an air compressor having a capacity greater than 600 cubic feet.

Let our engineers tell you about the advantages of Class "PRE" compressors with direct-connected synchronous motors. We would also be glad to send you copies of our Bulletin No. 3126.

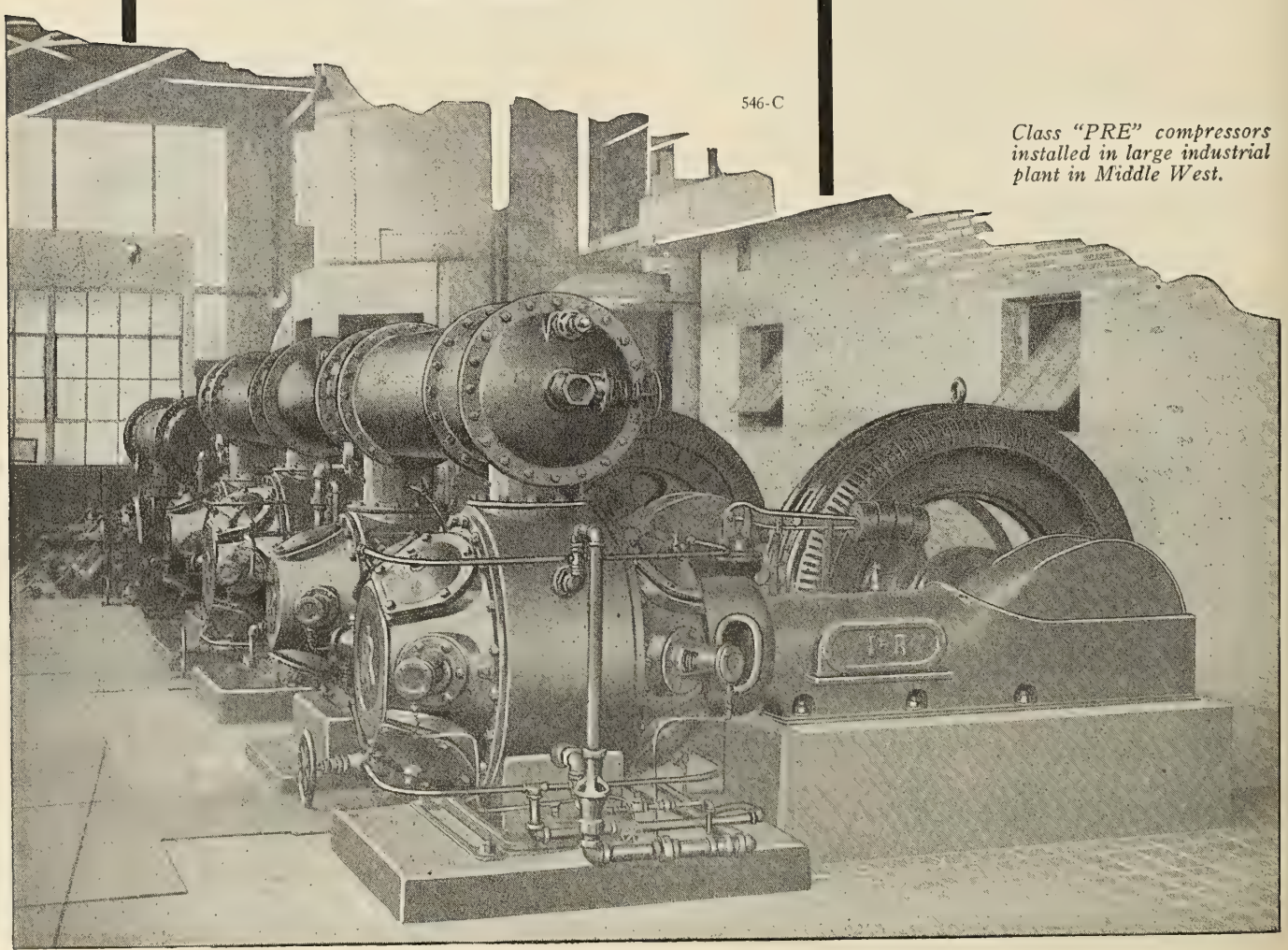
PRICE OIL ENGINES

Ingersoll-Rand Company

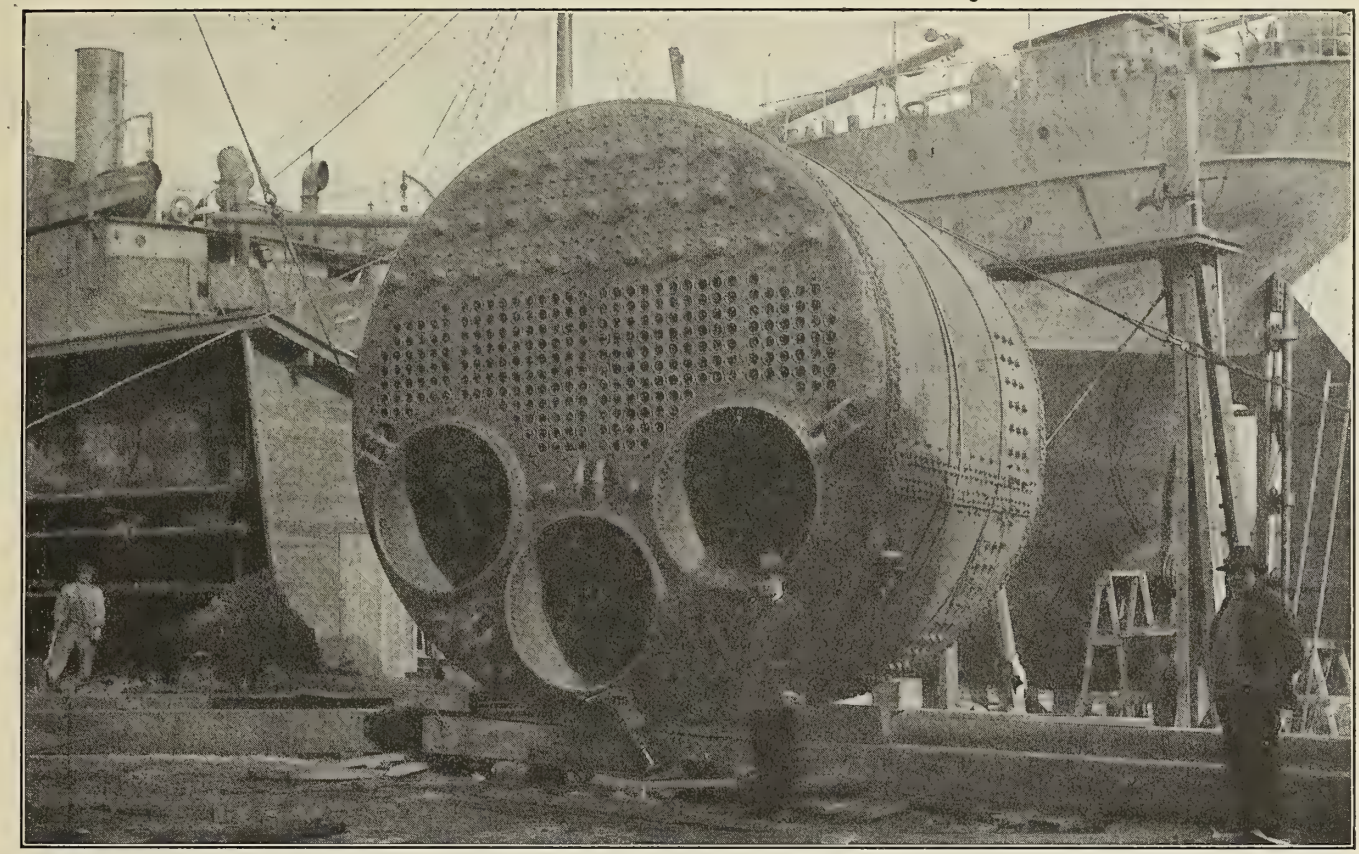
General Offices: 11 Broadway, New York

Offices Everywhere

546-C



Class "PRE" compressors installed in large industrial plant in Middle West.



"To See Is To Believe"

It's an old saying, but it just fits in with our story.

You noticed the Scotch Marine Boiler at the top of the page, didn't you?

It's 15′ 3″ in diameter, and the interesting thing about it is that the heads were made and flanged in one piece, which required flat circles 198¼″ in diameter.

Such work is possible because of the World's Largest Plate Mill and our spinning flanging machine.

Now the customer for whom we made the heads really did not believe it possible that the heads could have been furnished so nearly perfect, but he saw them and he believed.

You, too, should design Marine boiler heads in one piece—they do away with seams necessary in two-piece hand-flanged heads.

Lukens Steel Company

Coatesville, Pennsylvania

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SOLE EXPORTER OF OUR COMMERCIAL PRODUCTS CONSTECO CONSOLIDATED STEEL CORPORATION 25 BROADWAY, NEW YORK, U.S.A.

Ferguson-Herbert Corp'n

Think What Ferguson-Herbert Service Means—

Cast iron propellers of all sizes in stock ready for immediate shipment—bronze wheels built to your order on short notice—spare blades when you need them.

Miscellaneous gray iron castings—grate bars, bridge walls and castings for all kinds of equipment ready for you in the shortest possible time.

And our machine shop is exceptionally well equipped to handle rush orders.

Wharfage and dry dock charges are high—use our service to reduce them.

FERGUSON-HERBERT CORP.

Foundry and Machine Shop
Hoboken, N. J.

New York Office—95 Liberty St. K-38A

Foundry Service

Space—Important Aboard Ship

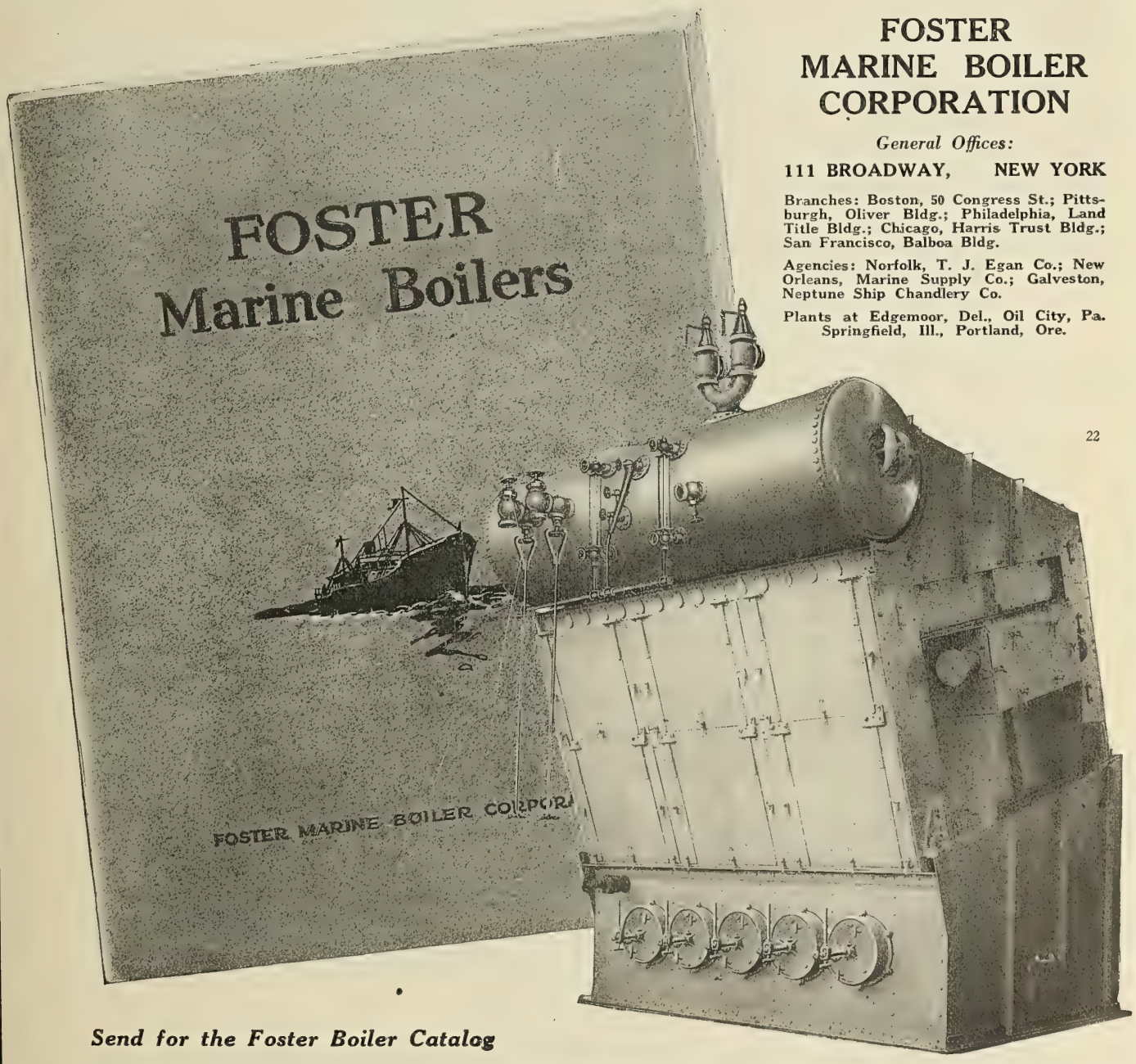
The space required by the propelling equipment aboard ship is an important item that is now receiving careful consideration. In ships of large power and high speed especially the space available for the boiler room will determine the type of boiler to be installed.

With small powered cargo ships, where the width of the midship section allows all the necessary boilers to be set in one fireroom athwartship, the space required is not as important as on larger powered ships where either fore-and-aft boiler rooms or more than one row of athwartship boilers are required. In such cases as in naval practice and in passenger liners, yachts, etc., where space, weight, and economy are all vital factors, the water-tube boiler is being used almost exclusively.

The limit of power in naval work and in large passenger liners was reached several years ago with Scotch boilers. The recent increase in speeds developed by these types of ships has been made possible by the adoption of water tube boilers.

Even on the slower merchant marine ships, the many advantages of the water-tube type of boiler are bringing about their rapidly increasing use and on this as on all other types of vessels, Foster Boiler records are helping to establish the superiority of the water-tube boiler. Foster Boilers can be adapted to any space, pressure, temperature or power condition required. Their large steaming capacity insures minimum space requirement for high power.

The Foster Catalogue shows clearly the space occupied in over one hundred installations.



FOSTER MARINE BOILER CORPORATION

General Offices:

111 BROADWAY, NEW YORK

Branches: Boston, 50 Congress St.; Pittsburgh, Oliver Bldg.; Philadelphia, Land Title Bldg.; Chicago, Harris Trust Bldg.; San Francisco, Balboa Bldg.

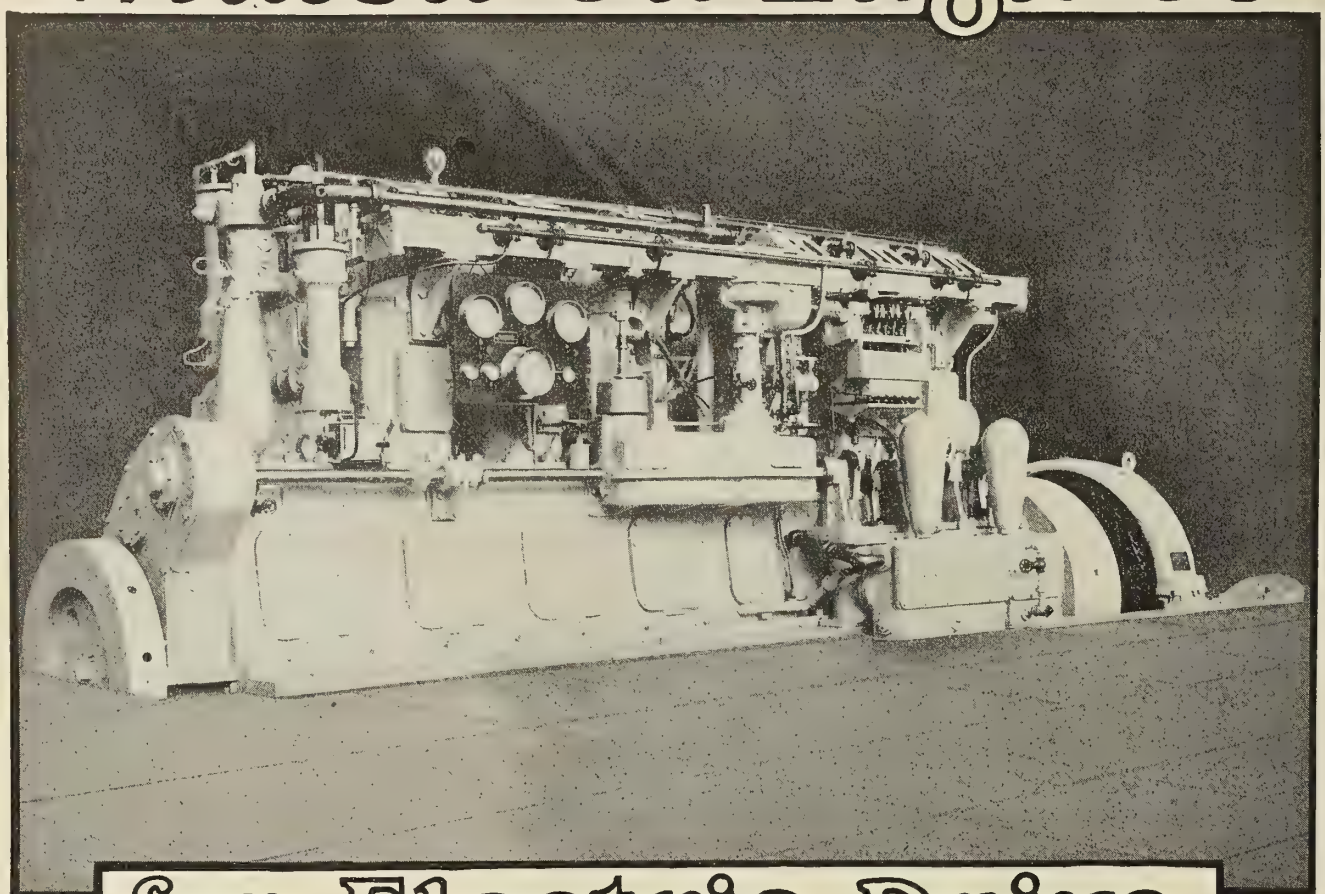
Agencies: Norfolk, T. J. Egan Co.; New Orleans, Marine Supply Co.; Galveston, Neptune Ship Chandlery Co.

Plants at Edgemoor, Del., Oil City, Pa. Springfield, Ill., Portland, Ore.

22

Send for the Foster Boiler Catalog

Winton Oil Engines



for Electric Drive

AN increasingly large number of Winton Diesel-Electric Drive Installations are being made, because these outfits are proving out in service to be splendidly efficient and extremely economical in operation.

A series of two or more Winton Oil Engines, each connected to a Westinghouse Generator, generating power and supplying it to a driving motor located in the stern, makes an ideal installation for many different types of ships. The power plant can be placed advantageously, it occupies less room than any other type of propulsion unit and requires a minimum of attention and labor. Its fuel is low in cost, easily stored and quickly taken aboard.

Write to-day for full details of Winton Diesel-Electric Drive Units and for the new Winton Catalog

WINTON ENGINE WORKS, CLEVELAND, OHIO, U. S. A.

New York—A. G. Griese, Inc., 30 Church Street
Washington—R. L. Fryer, 817 Albee Building
San Francisco—F. G. Bryant, 593 Market Street
Jacksonville—D. J. Carrison & Company
Seattle—H. W. Starrett, Sunset Engine Co.

Winton

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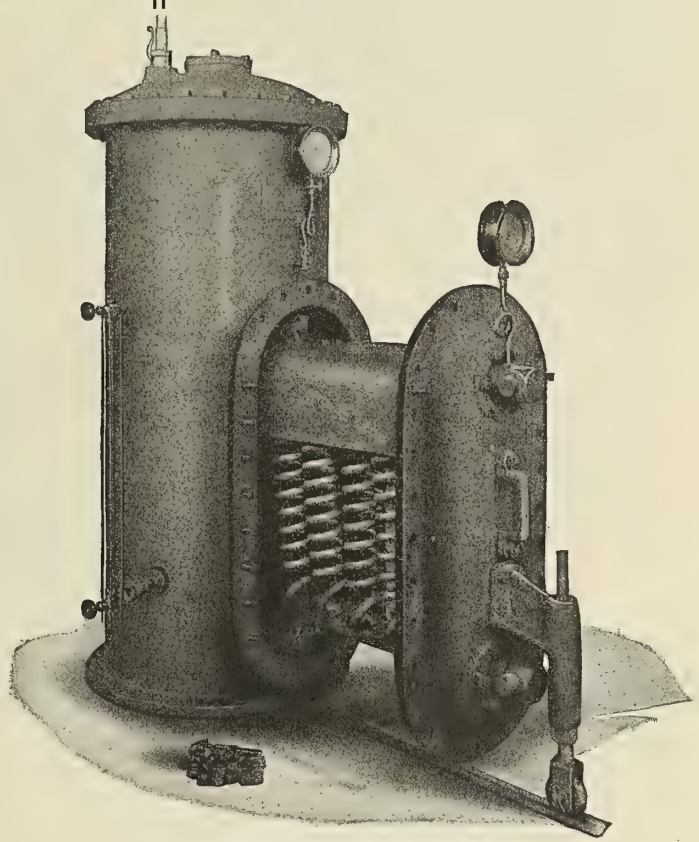
Quality Wins—
It's Inevitable!

Reilly Marine Auxiliaries

have maintained undisputed leadership in the marine field for over FIFTY YEARS



Reilly Evaporator—Self Sealing

Feed Water Heaters
Evaporators
Distillers
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Fuel Oil Heaters
Steam, Oil and Air Separators

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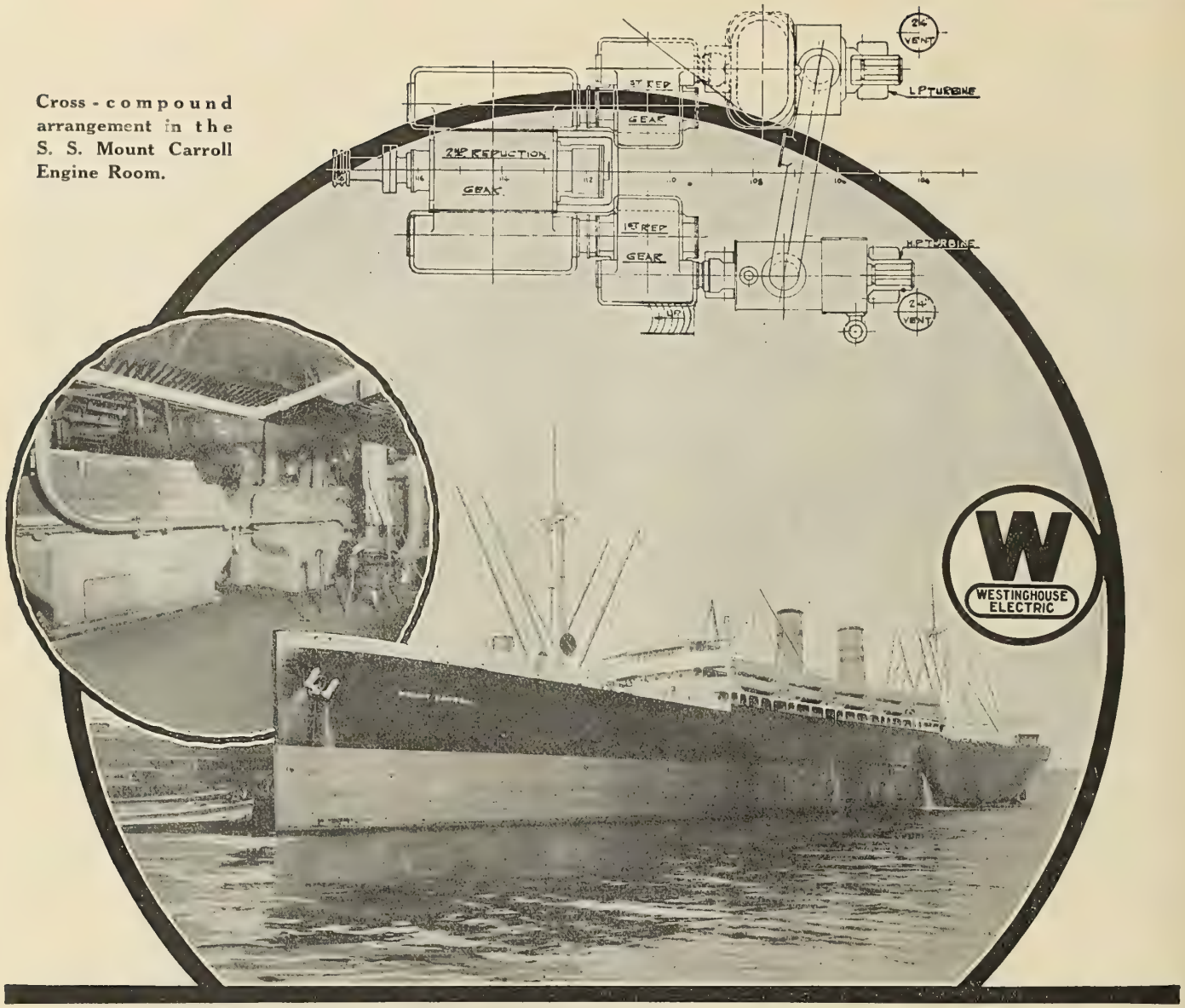

Cross-compound arrangement in the S. S. Mount Carroll Engine Room.

Reliable—Flexible—Economical

The S. S. Mount Carroll and the S. S. Mount Clinton, recently completed by the Merchant Shipbuilding Corporation, for service between New York and Hamburg, are the first ships contracted for by a private enterprise since the armistice. They enjoy also the distinction of being the first ships built in America for handling third class passengers, exclusively.

The propulsion equipment of these ships is of the cross compound type, consisting of a high and a low pressure turbine, which drives the propeller through a 3-case double reduction gear developing 4200 S.H.P. Either turbine may be disconnected and operation on the other will give 2/3 speed, making this a very flexible installation. The cross compound arrangement allows of highly economical design, the steam being expanded in two cylinders rather than in one.

One hundred and fifteen cargo carriers are equipped with the Westinghouse Electric & Mfg. Company's Cross Compound Geared Turbines.

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Offices in All Principal American Cities

Special Pacific Coast Representatives
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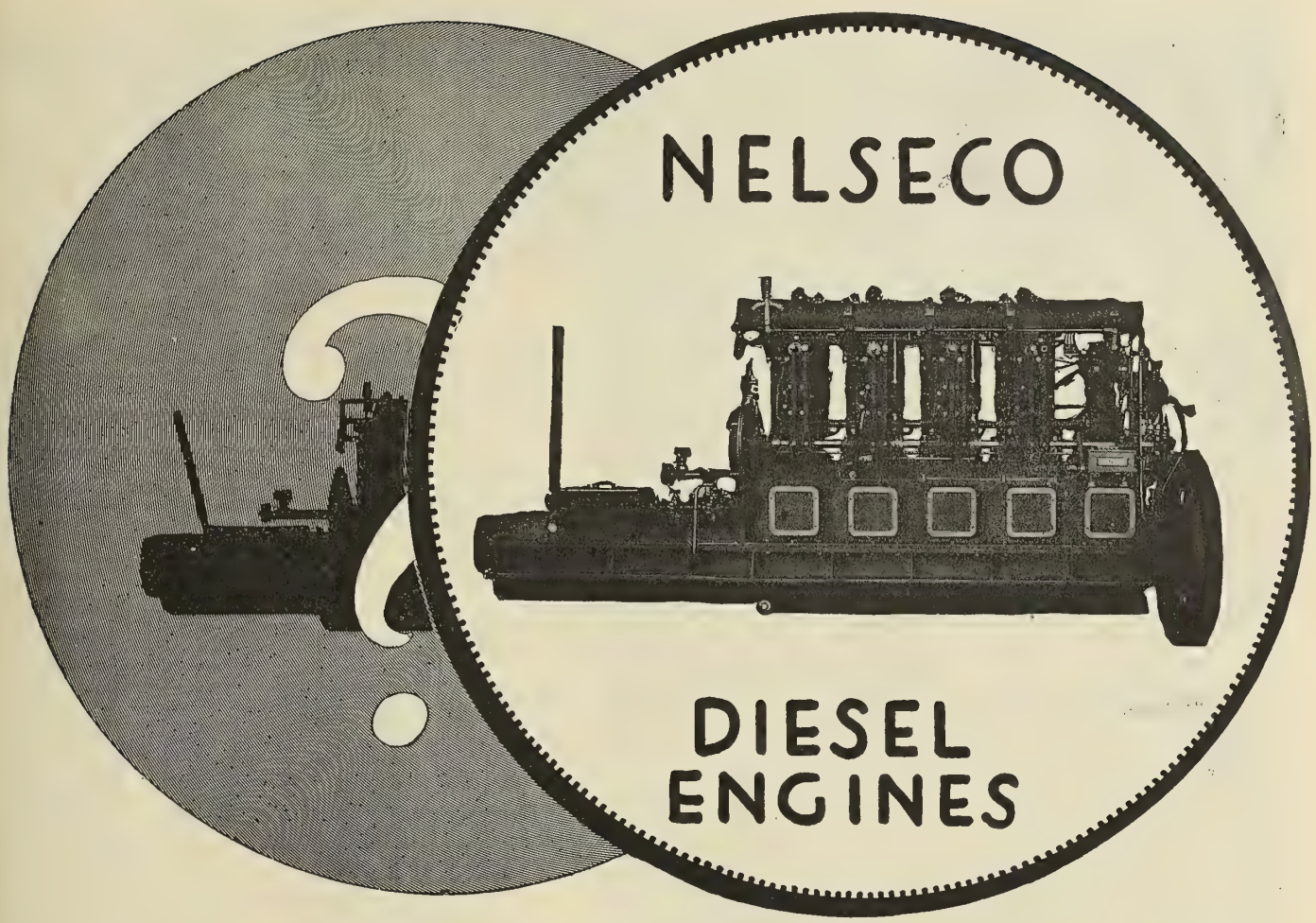
Westinghouse



Certainty—

THE SHADOW OF DOUBT
NEVER ENTERS THE MIND OF USERS
OF
NELSECO
MARINE DIESEL ENGINES

GOLD MEDAL
HIGHEST AWARD
MARINE DIESEL ENGINES
Panama-Pacific Exposition

Ships thus equipped are propelled efficiently and dependably with as low fuel consumption as is possible to secure through any like operation. Over 150,000 H. P. now in service in American and Foreign Vessels or on order.

Sizes: 120, 180, 240, 360, 480 to 2000 B.H.P.

NEW LONDON SHIP & ENGINE CO., Groton, Conn., U. S. A.

durability
Accumulated experience in the manufacture of WICKWIRE ROPE from the ore to the finished product, under exacting tests, makes this rope dependable.
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WORCESTER, MASS. BUFFALO, NEW YORK
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Long-Bell

TRADE MARKED

Lumber and Timbers

PRICE

Is Not the Main Factor in Lumber Buying

When properly manufactured, dense Southern pine (long leaf) has no superior for marine construction purposes meeting as it does to an unusual degree the main essentials —strength and durability. There can be no compromise with inferior woods in marine work. The demands for uniform strength and durability are too exacting for "savings" of that kind.

Careful and expert buyers of timbers and planking for marine construction do not buy on price alone but consider, rather, the *value* they will receive for the money. They recognize also that they are most likely to obtain the best values when they deal with manufacturers who have a reputation to sustain—a reputation that has been built on the basis of giving full value for the money.

For many years The Long-Bell Lumber Company has taken pains to produce Southern pine timbers and lumber products especially adaptable for ship, barge, dock and pier building. From tree to loading these materials are subject to vigilant inspection. To enable buyers to take advantage of our careful manufacturing and long experience we brand our trade-marked name upon all lumber and timbers. This brand has come to be an unquestioned assurance to many large buyers that they are getting products as nearly perfect as it is humanly possible to make.

The Long-Bell Lumber Company

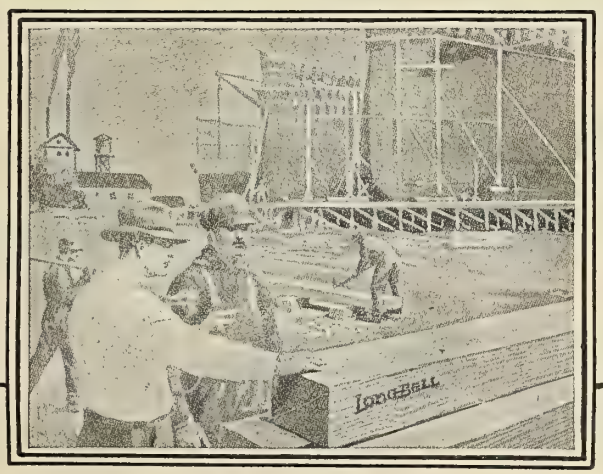
R. A. LONG BUILDING Lumbermen since 1875 KANSAS CITY, MO.

Southern Pine Lumber and Timbers

California White Pine

Sash and Doors

Standardized Woodwork



Creosoted Lumber, Timbers, Posts, Poles, Ties, Piling, Wood Blocks

Oak and Gum Lumber

Oak Flooring

Whenever the Task involves Towing
"Wall" Manila Hawsers
Always Merit the great Trust imposed

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Baltimore
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EST. 1830 WALL WALK LAID ROPE TRADE MARK

New Orleans
Galveston
Works: Beverly, N. J.

WALL ROPE WORKS, INC., 48 SOUTH ST. NEW YORK

and now-

LIQUID RED-LEAD

The same Dutch Boy Red-Lead as that used in paste form by so many shipping companies to protect ships and dock structures, but supplied as a liquid—ready for the painter's brush—for those who prefer to buy their paint that way.

Only a red-lead of the highest grade can be put out pure in liquid form.

This Liquid Red-Lead comes in six standard shades:

No. 1 Orange-Red	No. 7 Dark Brown
No. 5 Black	No. 8 Light Green
No. 6 Light Brown	No. 9 Dark Green

Straight red-lead, No. 1, should always be used for first coats. The other colors are recommended for finishing coats.

Dutch Boy Liquid Red-Lead is a notable development in the paint industry. Write us about it.

NATIONAL LEAD COMPANY

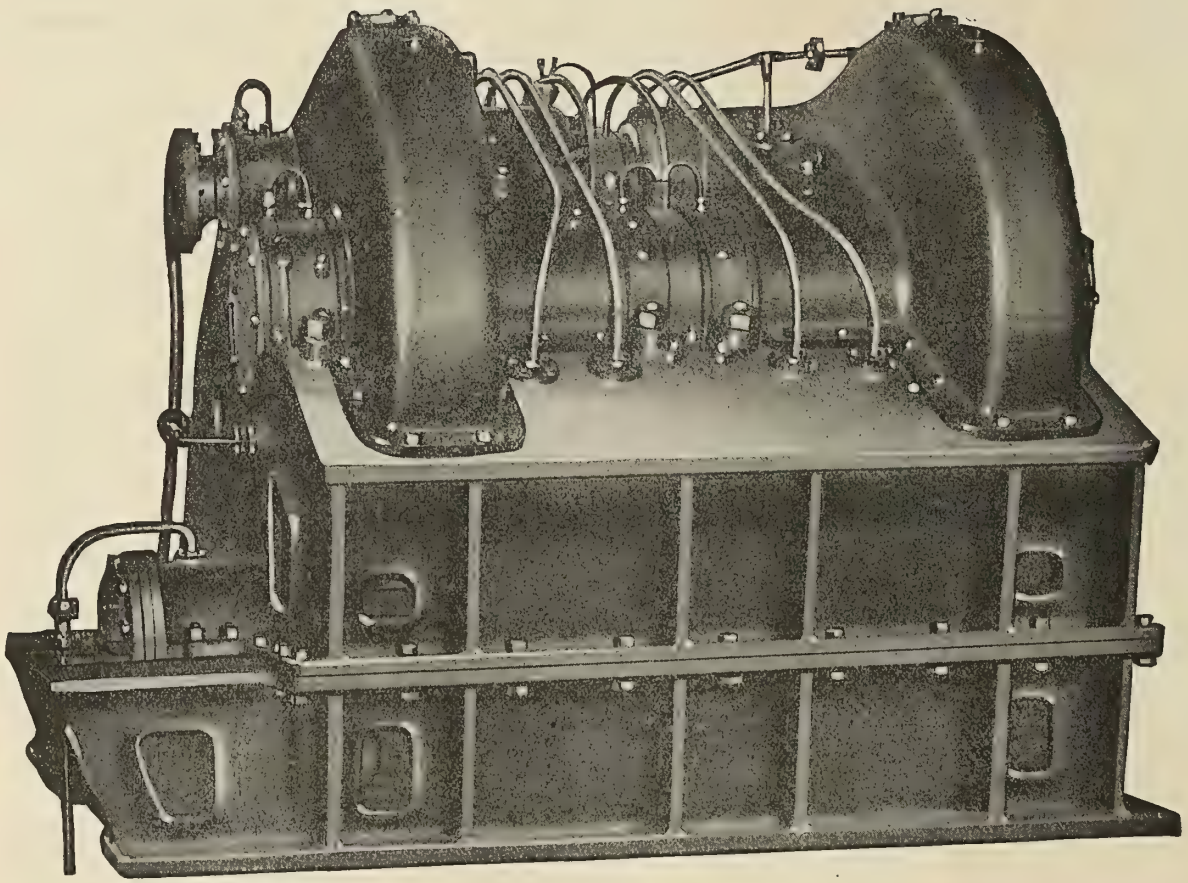
New York Boston Cincinnati San Francisco
Cleveland Buffalo Chicago St. Louis

JOHN T. LEWIS & BROS. CO., Philadelphia
NATIONAL LEAD & OIL CO., Pittsburgh

Dutch Boy
Liquid Red-Lead

FALK Herringbone GEARS

For MARINE SERVICE



Side View of Double Reduction Marine Gear for Single Turbine Drive,
1500 H. P., 3600 to 90 R. P. M., including Kingsbury Thrust Bearing

These gear units are built in the Largest and most Completely Equipped Plant in this country which is devoted exclusively to the building of high class reduction gears—for all purposes

Falk Corporation, Milwaukee, Wis., U. S. A.

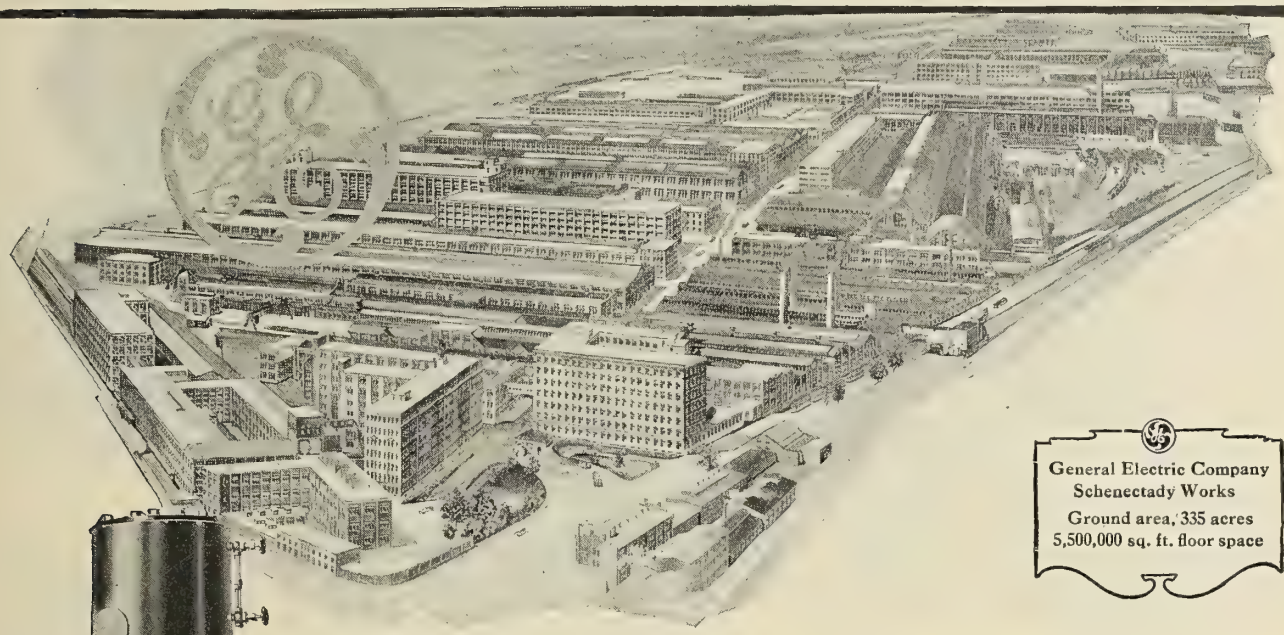
W. O. BEYER
1007 Park Bldg., Pittsburgh, Pa.

M. P. FILLINGHAM
50 Church St., New York City

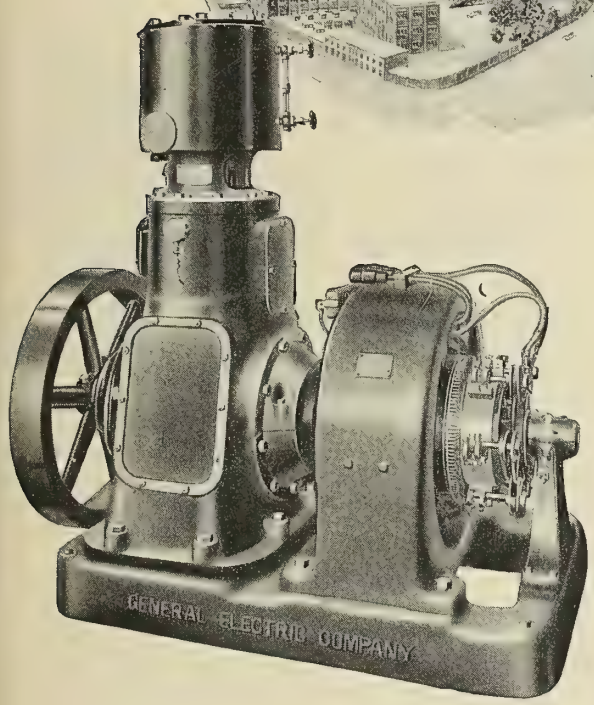
F. W. GRIMWOOD
Rialto Bldg., San Francisco, Cal.

263 St. James Street, Montreal, Quebec, Can.
ENGINEERING EQUIPMENT CO., Ltd.

When you examine a piece of equipment don't stop at the apparatus itself—look beyond and seriously consider the reliability of its maker.



General Electric Company
Schenectady Works
Ground area, 335 acres
5,500,000 sq. ft. floor space



G-E Steam Engine Driven Generating Sets The Standard of Quality

THE General Electric Company manufactures a line of small direct connected generating sets of the highest grade, electrically and mechanically.

In addition to their many specific points of superiority, these sets have the great advantage of being manufactured complete at one factory, which insures perfect fit, uniformity of finish and a thorough test of the combined unit before shipment.

Perfect alignment, balance, smoothness of operation make possible long running periods without continued attention and assure a very low maintenance cost. Ease of interchangeability and adjustment for wear is insured by the accurate construction of all parts. The materials used are of the kinds and qualities best adapted for the purposes intended and are advantageously employed in the execution of carefully prepared designs.

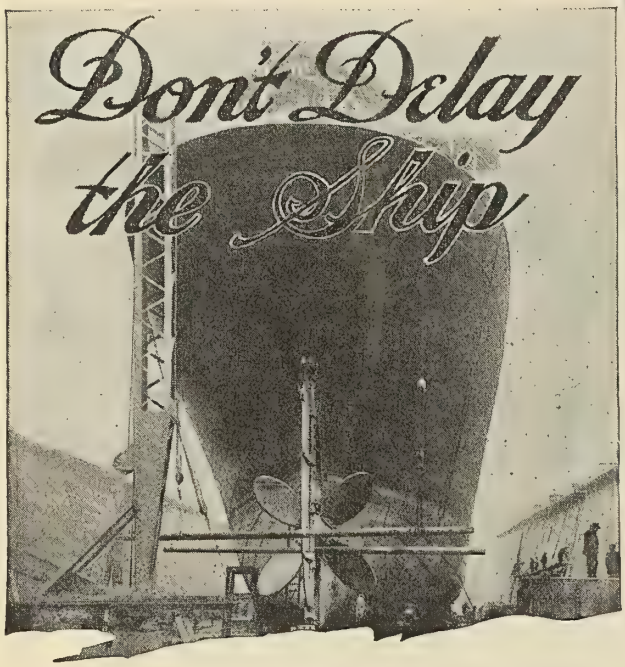
Send for Bulletin 42300 for detailed information.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

KEARFOTT
MARINE MACHINERY



Solves the Problem of Economical Running

through its lightness of weight, positive durability, great reserve power and perfect balance.

That is the reason why many of the largest mercantile shipping concerns prefer Kearfott Engines and mechanical equipment.

In Kearfott design every item calculated to keep operating costs cut to the bone is carefully considered.

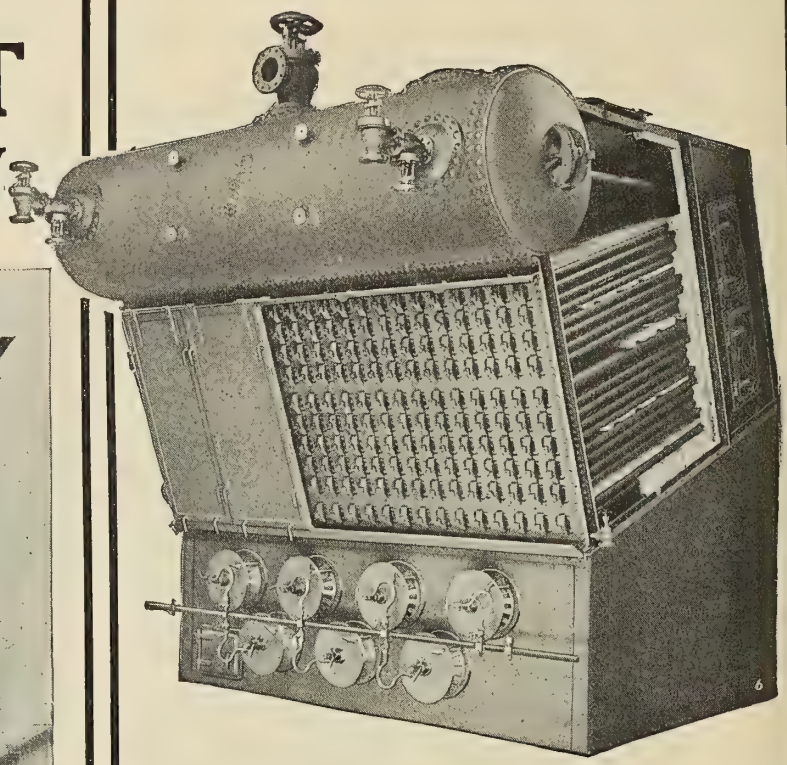
Main and auxiliary engines, draft fans, condensers, chase condenser tubes—Admiralty or Muntz Metal, Deck Machinery and a general line of Marine Mechanical Equipment—for prompt shipment at factory prices.

And Kearfott service is ready—at your disposal to show you how you can get the most out of your ship.

If it's a question of Marine Mechanical equipment consult Kearfott—we have years of experience to give you—let us help.

Kearfott Engineering Co., Inc.
95 Liberty Street, New York

K-37



WARD BOILERS
Are Keeping America's Merchant Marine Fit

in lessening breakdowns, in making better time in voyage, in standing up under forced action—and in keeping ships and freight moving.

Made to burn either coal or oil,—compact steel construction—strong and light, Ward Watertube Boilers cut down upkeep and operating costs to a minimum.

Seamless straight drawn tubes expanded in—front and rear header frames carefully machined and fitted—all parts designed with a high factor of safety, are items that go to make the Ward Boiler absolutely reliable.

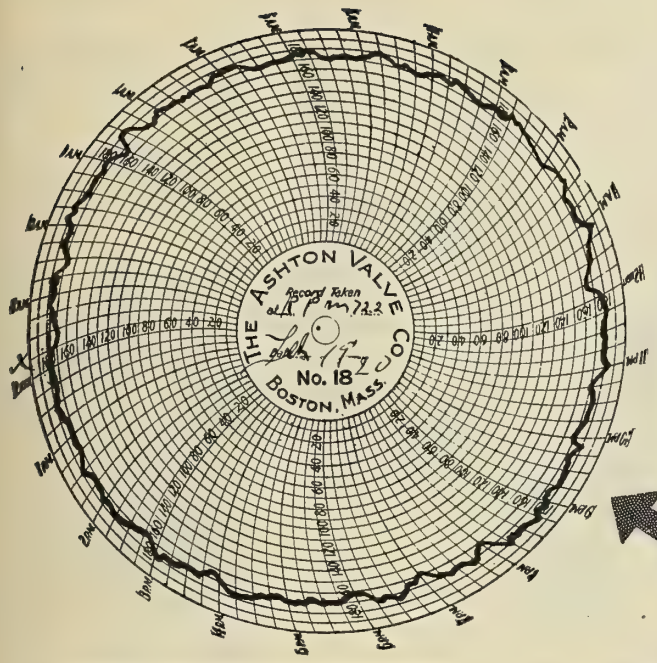
Seventeen pounds of water evaporated to one pound of oil burned, and steam in 20 minutes are everyday Ward performances.

You will be interested in other Ward features too—Let us tell you of them.

The Charles Ward Eng. Works
Charleston, W. Va.

Eastern Agent
Kearfott Engineering Co., Inc., 95 Liberty St., N. Y.

WB-37



BEFORE
Installing Diamond Soot Blowers on S. S. Delfina
Stack Temperatures 600° to 615°
Average Revolutions about 72

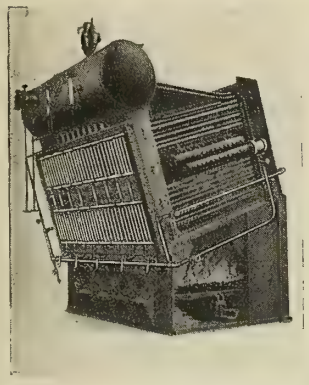
Which?

Do Your Boiler Logs Show High or Low Operating Costs?

It is just as easy, and a great deal more satisfactory and desirable to operate your vessel economically as regards the power end, rather than wastefully. Take the case of the S. S. "Delfina," a Shipping Board vessel now operated by the Munson Line and running between New York and Buenos Aires. This vessel was originally a poor steamer; the stack temperatures were very high and the stack had taken fire due to the increased accumulation of soot. In order to eliminate these troubles and to decrease the fuel consumption, and increase the boiler efficiency, Diamond Soot Blowers were installed.

An immediate difference was apparent. The chart above, taken before the installation of Diamond Soot Blowers, shows an average steam pressure of 180 pounds. The average revolutions of the engine were 72 and stack temperatures were 600 to 615 degrees. As soon as Diamonds were installed the average boiler pressure jumped to 200 pounds, where it was easily maintained, the stack temperatures decreased to 450 to 475 degrees, and the average revolutions increased to about 80 per minute. A very marked saving in fuel also resulted. As a result of these savings, all of which are directly traceable to Diamond Soot Blowers, the Delfina now operates on a much more economical basis than ever before.

Diamond Soot Blowers are the best paying investment you can place in your vessel. For further information write for Bulletin No. 134.



The Delfina has Foster Boilers equipped with Diamond Soot Blowers

The blowers are of the front end type with nozzles extending through the hollow staybolts. The blowers are made up in vertical sections, each under the control of an individual valve. This arrangement permits of blowing three or four vertical rows of tubes at one time, thus avoiding all interference with the draft. Over 300 Foster Marine watertube boilers have been equipped with Diamond Soot Blowers.

"It gives me great pleasure to state that Diamond Soot Blowers have made good every claim made for them.

"The S. S. Delfina is equipped with three Foster Boilers and uses oil fuel.

"On voyage from Gulfport, Miss., to Buenos Aires the following averages were obtained:

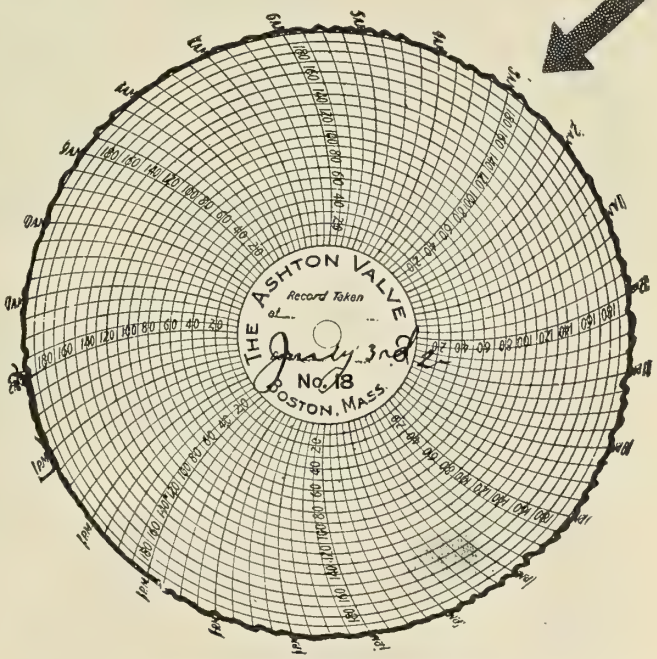
Steam pressure 200 pounds, Revolutions of main engines, 79.5 per minute.

Fuel consumption, 68.7 barrels per 100 miles.

Stock temperature, 440 degrees.

"I, therefore, recommend Diamond blowers for all types of boilers using coal or oil for fuel."

F. W. Failmore,
Chief Engineer.



AFTER
Installing Diamond Soot Blowers on S. S. Delfina
Stack Temperatures 450° to 475°
Average Revolutions about 80

DIAMOND POWER SPECIALTY COMPANY
Detroit, Michigan

Diamond

SOOT BLOWERS - SAVE 4 to 8% FUEL

Cleco

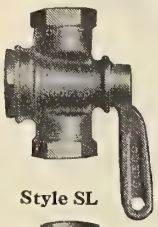
PRESSURE-SEATED AIR VALVES

THE VALVE THAT NEVER LEAKS

Cleco Valves improve with use; they do not require any attention after installation.

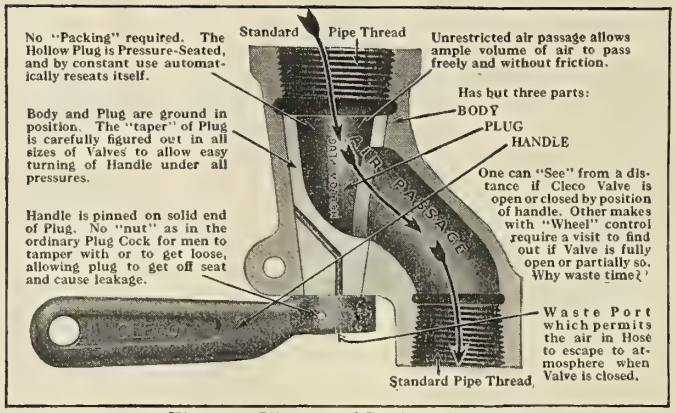
Cleco Valves are made in sizes to suit all requirements from ¼-in. to 2-in. outlets.

Cleco Valves fill all requirements between Air Compressor and Air Tools.



Style SL

Style FW


No "Packing" required. The Hollow Plug is Pressure-Seated, and by constant use automatically reseats itself.
Body and Plug are ground in position. The "taper" of Plug is carefully figured out in all sizes of Valves to allow easy turning of Handle under all pressures.
Handle is pinned on solid end of Plug. No "nut" as in the ordinary Plug Cock for men to tamper with or to get loose, allowing plug to get off seat and cause leakage.
Standard Pipe Thread
Unrestricted air passage allows ample volume of air to pass freely and without friction.
Has but three parts:
BODY
PLUG
HANDLE
AIR PASSAGE
One can "See" from a distance if Cleco Valve is open or closed by position of handle. Other makes with "Wheel" control require a visit to find out if Valve is fully open or partially so. Why waste time?
Waste Port which permits the air in Hose to escape to atmosphere when Valve is closed.
Standard Pipe Thread

Write for Illustrated Bulletin No. 48

Style LW

Style FWL

Style A

There is a Cleco Valve made for every need on Air Systems, from Compressor to the Air Tool and for Hose Lines.

Style PO

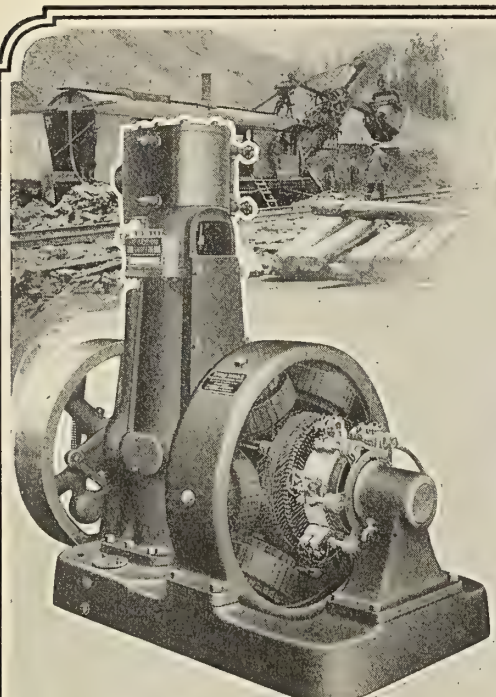
Multiple Outlet Valves are made in all sizes for Machines having Double-Acting Pistons and for Foundry Molding Machines.

Style RA

THE CLEVELAND PNEUMATIC TOOL COMPANY, Main Office and Works CLEVELAND, OHIO

New York Boston St. Louis Chicago Philadelphia Pittsburgh San Francisco Detroit Minneapolis

CLEVELAND PNEUMATIC TOOL CO. of Canada, Limited 84 Chestnut St., Toronto, Ont. 84 Craig St. W., Montreal, Que.

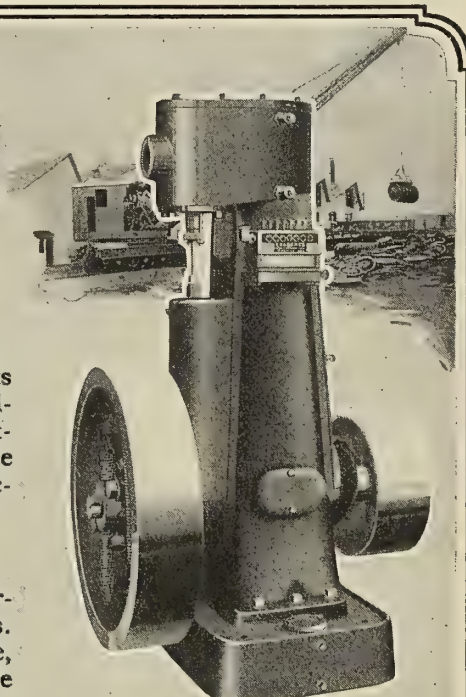


GENERATING SETS
1 TO 50 K. W.
Described in Catalog 103

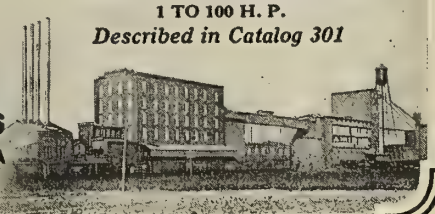
Engberg
THE STANDARD FOR EFFICIENCY-DURABILITY -SERVICE

Engberg Generating Sets are most economical and dependable, making them especially satisfactory for all kinds of service where continuous and satisfactory operation is desired.

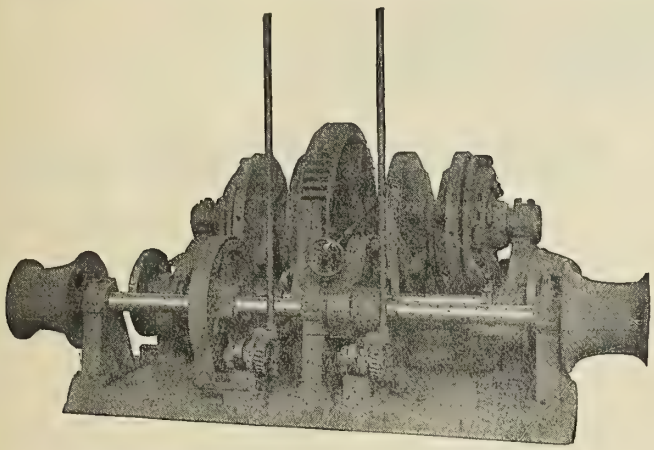
Engberg Engines are desirable for all power purposes. They combine every distinctive, discriminating and serviceable feature essential for proper performance.



VERTICAL ENGINES
1 TO 100 H. P.
Described in Catalog 301



ENGBERG'S
ELECTRIC & MECHANICAL WORKS
6 VINE ST., ST. JOSEPH, MICHIGAN, U.S.A.



THE HYDE STEAM WINDLASS SPUR GEARED TYPE

HIGH-GRADE MARINE AUXILIARY MACHINERY

WINDLASSES—STEERING ENGINES AND STEERING GEARS—CAPSTANS—CARGO WINCHES—STEAM, HAND AND ELECTRICALLY OPERATED

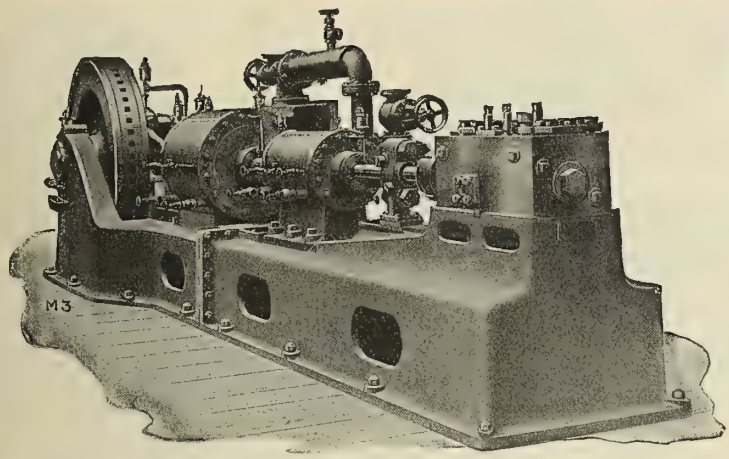
WHEN ORDERING SPECIFY

"HYDE"

HYDE WINDLASS COMPANY, BATH, ME.

New York Office, 25 West 43d Street

1



FRICK

Mechanical Refrigeration

Heavily built and reliable machinery is essential in the successful operation of the modern refrigerating plant. The Quality, Efficiency and Durability of **FRICK** Refrigerating Machinery are never questioned.

stands for better sanitary conditions, even temperatures, improvement in the quality of the goods stored and a reduction in the amount of goods lost.

CO_2 Compression and **Ammonia Compression** Refrigerating units in any size to meet requirements.

WRITE FOR PRICES AND DETAILS

BRANCHES:
New York, N. Y. Philadelphia, Pa.
Baltimore, Md.

Frick Company
WAYNESBORO, PA., U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

DISTRIBUTORS:
New Orleans, La. Philadelphia, Pa.
San Francisco, Cal. Buffalo, N. Y.
Los Angeles, Cal. Detroit, Mich.
Seattle, Wash.

CLEVELAND

Punches & Shears

Vertical open gap machines are made with capacities from ½" hole through ½" material to 6" hole through 1½" material and with throat depths ranging from 6" to 72". Drive may be either belt or motor.

Wall Radial Drills

Can be furnished with horizontal arm from 6′ to 20′ inclusive. The No. 1 Machines have a stationary wall back while the No. 3 Machines have a 6′ vertical adjustment to the horizontal arm.

Plate Planers

Cleveland Machines are built in three types, the maximum distance between housings being governed by the capacity of the machine. The standard carriage is equipped with a swiveling tool holder carrying two tools, for cutting in either direction.

Punch and Die Department

In this Department we make a specialty of the manufacture of high grade punches and dies, rivet sets and other small tools used by fabricators.

Small Tool Catalogue sent on request

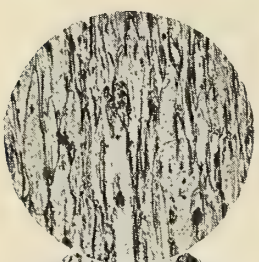
Sound judgment must be exercised in buying small tools and machine tools. The products themselves represent only what is visible to the eye and what is represented or misrepresented by the seller—the real criterion is *the organization back of them.*

THE CLEVELAND PUNCH & SHEAR WORKS CO.
Main Office & Works · CLEVELAND, OHIO
PITTSBURGH - CHICAGO - PHILADELPHIA - NEW YORK

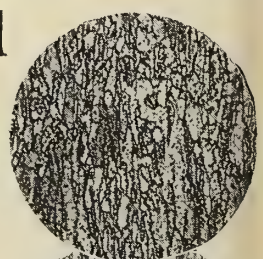
Scientifically Controlled Heat Treatment

is essential to high grade

WELDING RODS and ELECTRODES



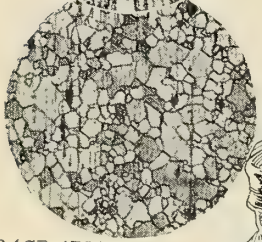
Photomicrograph showing grain structure due to improper annealing, typical of inferior gas welding rods



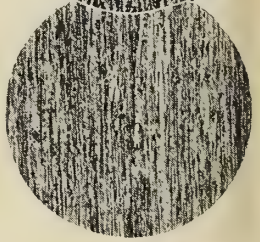
Photomicrograph showing grain structure of improperly annealed electrodes

The appearance, "feel" or stiffness of a Welding Rod or Electrode does not determine its welding qualities except to distinguish Gas Welding Rods (annealed) from Electrodes (hard drawn). The chemical properties and physical structure of the wire are the only safe guides to weldability.

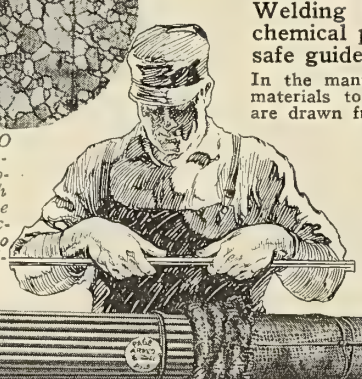
In the manufacture of PAGE-ARMCO there is no guess work, from the raw materials to the finished wire. PAGE-ARMCO Welding Rods and Electrodes are drawn from the purest iron ingot in the world—(99.87% iron) free from gas pockets, blow holes and other physical defects found in typical steel ingots. Then by scientifically controlled operations, one of the most important of which is heat treatment, the exact structure of the metal is produced for best welding practice.



PAGE-ARMCO Gas Welding Rods photomicrograph showing large grain structure due to proper annealing.



PAGE-ARMCO Electrodes photomicrograph showing elongated grains due to special heat treatment



PAGE STEEL & WIRE CO.

GENERAL SALES OFFICE: Grand Central Terminal, New York City
DISTRICT SALES OFFICES: Chicago, Pittsburgh, San Francisco, Portland, Ore.

PAGE-ARMCO
WELDING RODS and ELECTRODES

PARKESBURG
Charcoal Iron Boiler Tubes

Dependable Boiler Tubes

SHIP operation cannot be jeopardized by boiler tubes of doubtful service.

Tube failures at sea are too serious, too costly, too dangerous.

The charcoal iron boiler tube of established dependability and assured service is the only tube that should ever be put in a marine boiler.

Charcoal Iron Boiler Tubes—and nothing else—are made by Parkesburg.

Specify Parkesburg Tubes.

PARKESBURG IRON COMPANY

PARKESBURG, PA.

New York Boston Philadelphia Chicago New Orleans
San Francisco Norfolk St. Louis St. Paul

POST'S MOTOR MARINE WHITE METAL

THE REAL BABBITT METAL

for heavy pressure bearings, crank pins, slides and thrust bearings in all types of marine engines.

Standard in the largest shipyards.

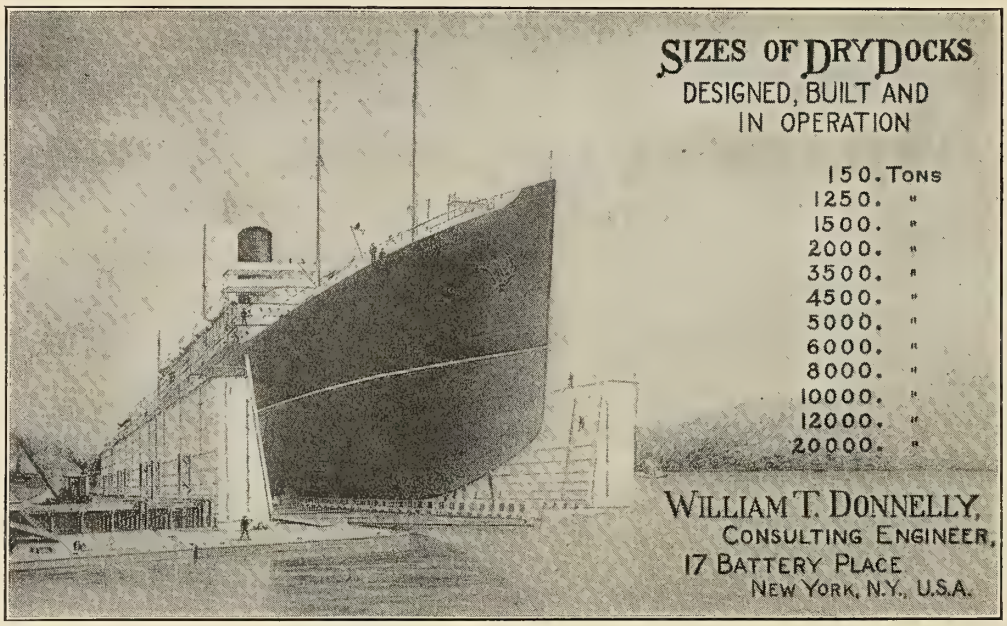
Specified by leading naval architects and steamship owners for all bearings of Diesel type engines.

We guarantee our metals to be made 100% of virgin raw materials of the highest grades at all times.

E. L. Post & Co., Inc.

Sole Manufacturers

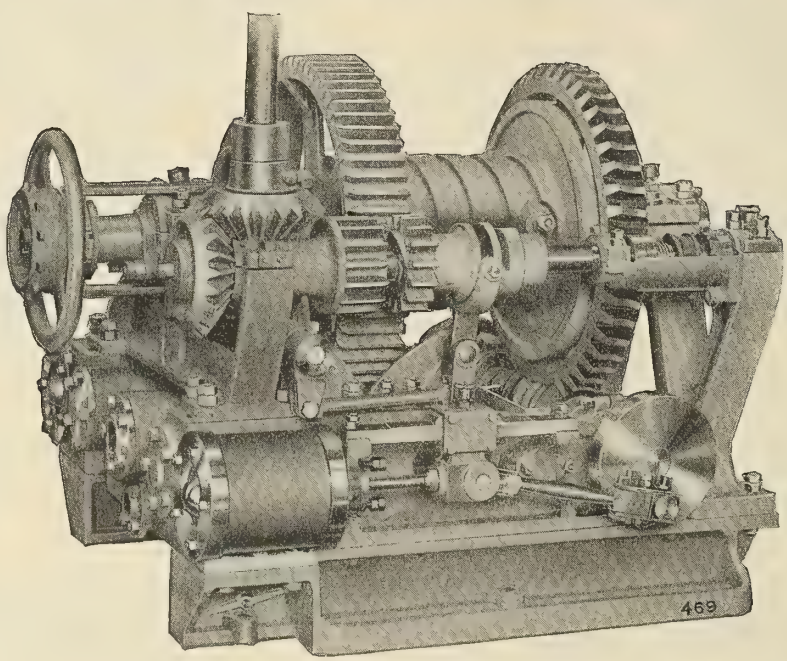
50 Cliff Street **New York**



DRY DOCKS RECENTLY DESIGNED AND BUILT

BETHLEHEM SHIPBUILDING CORP.....20,000, 10,000, 6,000 TONS
ALABAMA DRYDOCK & SHIPBUILDING COMPANY..10,000 TONS
JAHNCKE DRYDOCK & SHIP REPAIR COMPANY.....10,000 TONS
GALVESTON DRYDOCK & CONSTRUCTION CO.....10,000 TONS
W. and A. FLETCHER COMPANY..... 8,000 TONS
SUN SHIPBUILDING COMPANY .....10,000 TONS
FEDERAL SHIPBUILDING CO..... 8,000 TONS

LIDGERWOOD STEERING ENGINES



withstand the shock of heavy seas

They have the strength in design and construction that insures their standing up under the most severe service. They give full and prompt response to every movement of the wheel.

Cargo Winches

Lidgerwood "1917" Winches are the recognized standard today.

Over 6,000 in use.

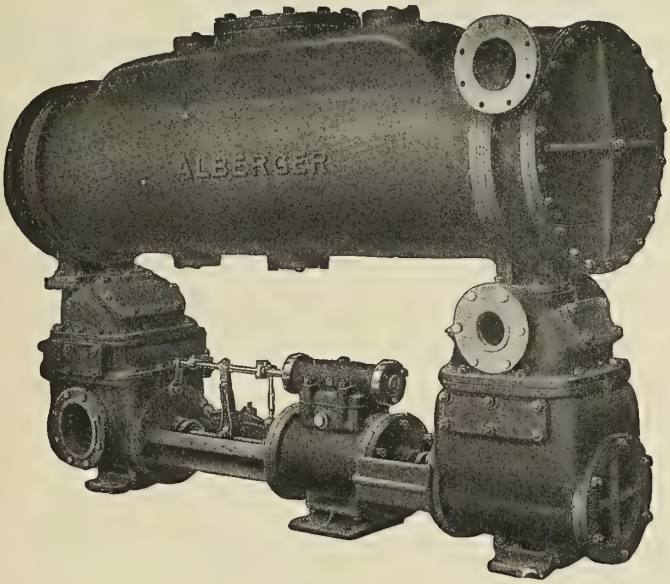
Send for Catalog of Marine Machinery

LIDGERWOOD MFG. CO., 96 Liberty St., New York

BRANCHES

Philadelphia Pittsburgh Chicago Cleveland Detroit Charleston, W. Va. Los Angeles Seattle London, Eng.

ALBERGER MARINE CONDENSERS



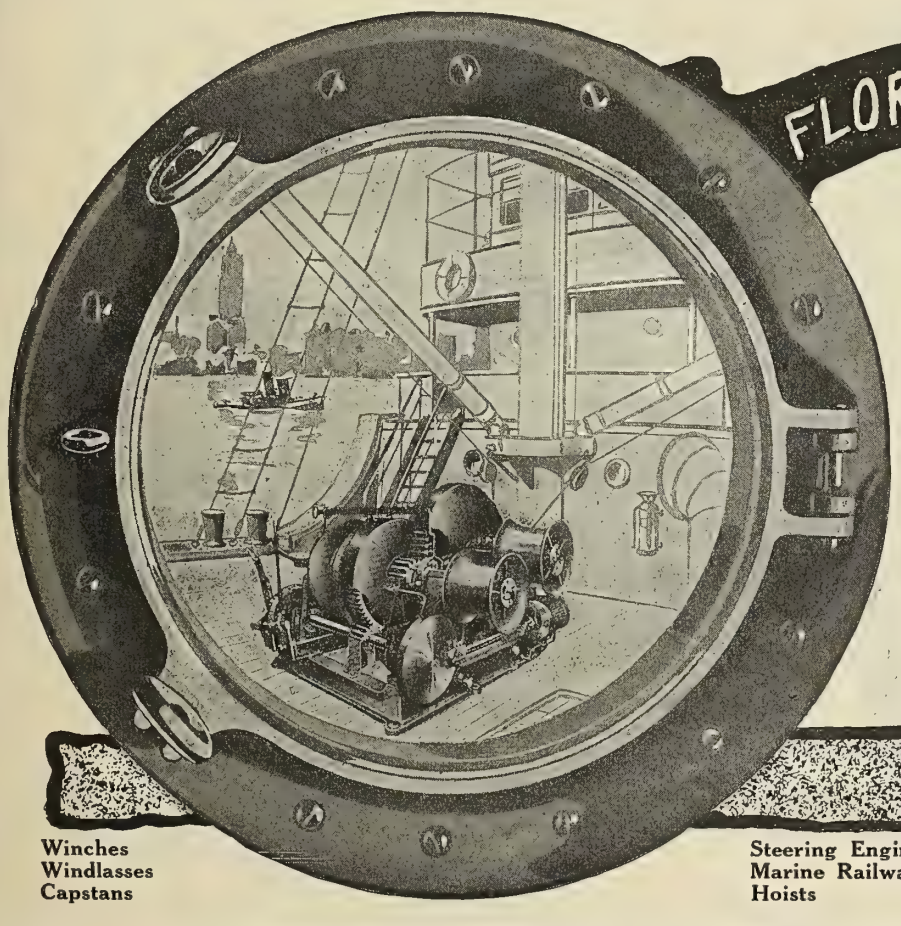
These units are arranged for greatest possible capacity in smallest possible space and afford maximum efficiency with accessibility for inspectors and repair.

Bulletin sent on request. Prospective purchasers will be supplied with dimension prints of sizes needed.

ALBERGER PUMP AND CONDENSER COMPANY

140 CEDAR STREET, NEW YORK, N. Y.

Boston Philadelphia Chicago St. Louis



FLORY

Ship Winches

Every time I look through that port I see a Flory winch

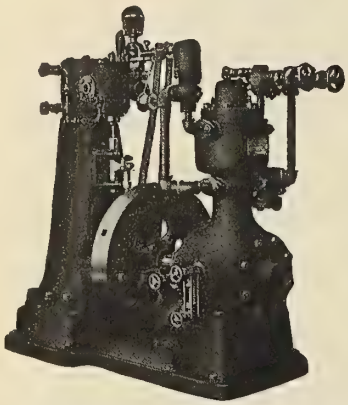
S. Flory Mfg. Co., Bangor, Pa.
95 Liberty St., New York City

Winches
Windlasses
Capstans

Steering Engines
Marine Railway Outfits
Hoists

Derricks
Cableways
Dredging Machinery

YORK MARINE REFRIGERATING MACHINERY



—is designed and built to meet the exacting conditions encountered on board ships—Reliability and Flexibility in operation, occupying a minimum deck space and headroom.

The special design and arrangement of the Compressor and Engine, or Motor, on the same bed plate enables both to be dissembled without additional deck space.

The Compressors—both Ammonia and CO_2—are built in various types and sizes, from ¼ ton refrigerating capacity upwards, and may be actuated by any available power.

Condensers, Brine Coolers, Scuttle Butts and Ice Making Systems are likewise varied in type and design to suit the particular ship on which they are installed.

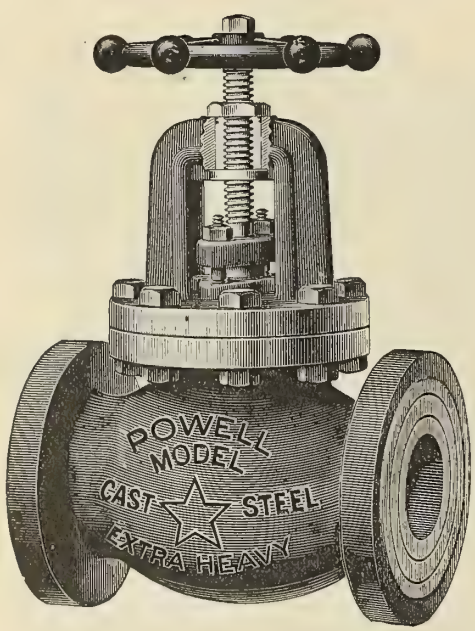
York Refrigerating Systems are scientifically designed and built by Specialists, who have devoted over 35 years to the development of this class of machinery exclusively.

Consultation on any Refrigerating Problem invited.

YORK MANUFACTURING COMPANY

YORK, PA.

POWELL VALVES



Write for descriptive circular

MADE OF THE HIGHEST GRADE OF

Cast Steel

Some of the largest shipbuilding companies in the United States are specifying

Powell Cast Steel Valves

They are absolutely dependable in every particular, being entirely free from porous defects. All valves are given a thorough tensile strength and hydrostatic pressure test before shipments are made.

Specify POWELL CAST STEEL VALVES

THE WM. POWELL CO.

DEPENDABLE ENGINEERING SPECIALTIES

CINCINNATI, OHIO

1276-1279

Better Than The Law Demands

A ship wireless equipment may meet the requirements of the law, and yet it may be ten years behind the radio times.

The set which is installed on a ship by the Radio Corporation of America always embodies the highest engineering skill. It is far more efficient than the law demands—far more trustworthy. It is the result of the systematic development of wireless by the Radio Corporation of America over a period of twenty years.

Thousands of vessels are now equipped with the efficient apparatus of the Radio Corporation of America—apparatus which is better than the law demands.

The sets of the Radio Corporation of America are the most efficient that scientific skill can produce. For behind the Radio Corporation of America stand the splendidly equipped Research Laboratories of the General Electric Company, The American Telephone & Telegraph Company and The Western Electric Company, where, year in and year out, eminent physicists conduct investigations that result in new radio advances. No other company enjoys the benefit of this scientific research in the field of radio communication.

Radio Corporation of America

WORLD WIDE WIRELESS

Edward J. Nally, *President*

WOOLWORTH BUILDING ~ NEW YORK CITY

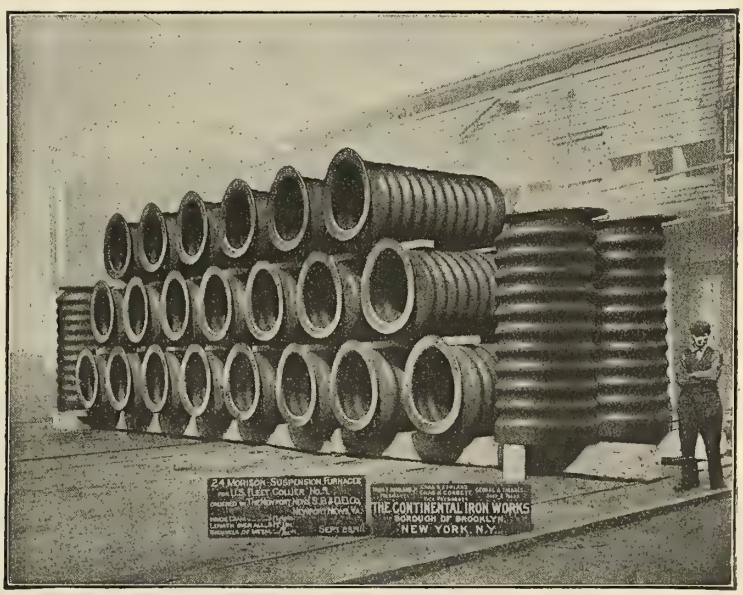
BRANCH OFFICES IN THE U. S. A.:

Boston	Philadelphia	Baltimore	Norfolk	Savannah
New Orleans	Galveston	Port Arthur	Cleveland	Chicago
Seattle	Portland	San Francisco	San Pedro	Honolulu

MORISON SUSPENSION FURNACES

for

LAND and MARINE BOILERS



UNIFORM THICKNESS
EASILY CLEANED
UNEXCELLED STRENGTH

MADE TO UNITED STATES,
LLOYDS, BUREAU VERITAS
OR ANY OTHER REQUIREMENTS

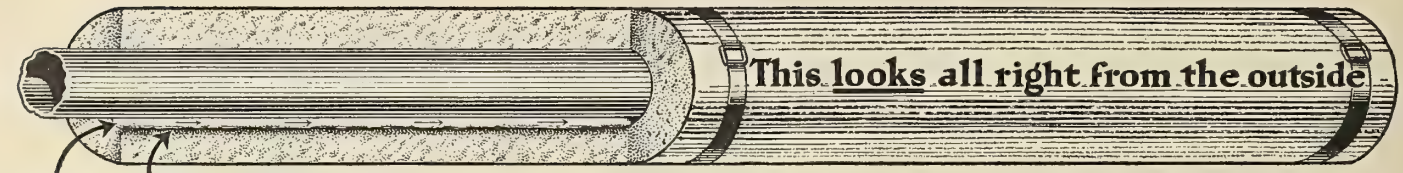
MADE IN THE UNITED STATES BY

THE CONTINENTAL IRON WORKS

West and Cayler Streets, Borough of Brooklyn, N. Y.

Established 1859 Greenpoint Ferry from East 23rd Street, New York Incorporated 1887

The High Cost of Sagging



But here is where the Covering has Charred and Sagged and Failed

Ask a man "How does a pipe-covering fail?" and usually he has to take a little time to answer. As long as a covering looks all right from the outside, the natural thing is to assume that it is doing its work well.

As a matter of fact, though, some pipe coverings contain from 20 to 22 per cent. of inflammable material. Under high temperatures, this results in a charring of the inner zone of the covering. Bulk having been reduced, the weight of the covering causes a sagging on the lower side. This creates air currents which escape at the joints.

Shove a thin metal rule up through the joints of some of your pipe coverings from the under side and see whether or not this sagging has taken place. If so, your coverings may look snug but *they are robbing you daily.*

Even heat as high as 800 to 900 deg. F. does not char 85% Magnesia Pipe and Boiler Covering. In several noteworthy tests, these temperatures are shown to actually increase the insulating efficiency of the covering *about three per cent.*

Ask for a copy of "Defend Your Steam," a thorough, well illustrated treatise on heat insulation, giving other valuable information.

MAGNESIA ASSOCIATION of AMERICA

753 Bulletin Building, Philadelphia, Pa.

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SOLID AND BUILT UP WHEELS ALL SIZES

Earliest delivery, lowest quotations, accurate pitch, perfect balance. Guarantee tests. 65,000 lb. tensile strength, 35 per cent elongation.

More than one hundred large steamship propellers delivered in year ending July, 1921, for vessels of leading steamship companies and U. S. Shipping Board.

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Represented by

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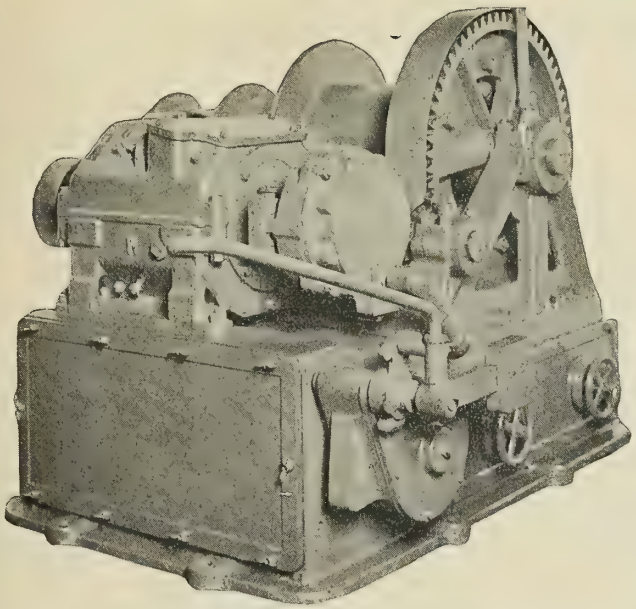
"CUNNINGHAM" QUALITY DECK MACHINERY



ELECTRIC CARGO WINCH
Ruggedly built, Waterproof, Simple, Accessible, and "Fool Proof."

Largest number of Electric Winches installed on American Merchant Ships have been designed and built by **Allan Cunningham Co.** and have been demonstrated superior to all other types in speed and safety in handling cargo, economy in operation and repair costs.

The Electric Winches are designed and built with the same care and thoroughness as the well known **Cunningham** steam machinery and equipment.

They are not experimental but have been demonstrated as satisfactory in five years' service.

CUNNINGHAM STEAM MACHINERY AND EQUIPMENT

Have earned reputation for unequalled satisfaction in service. Early deliveries can be made of either Steam or Electric Equipment.

ALLAN CUNNINGHAM COMPANY, Inc.

Builders of Steam and Electric Winches, Windlasses, Capstans, Steering Gears and Telemotors.

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G. E. Swett
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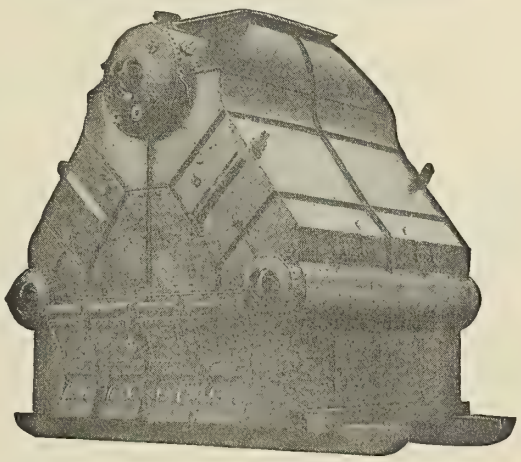
LUDLUM WATER TUBE MARINE BOILER

The New Marine Standard

A Self Contained Unit

Shipped Completely Erected

Unequalled Compactness



On Skids, Ready for Shipment as a Unit

All Wrought Steel

No Stay Bolted Surfaces

A Superior Oil Burner

Quick deliveries assured from ample stock of material on hand.

Write for the Catalogue.

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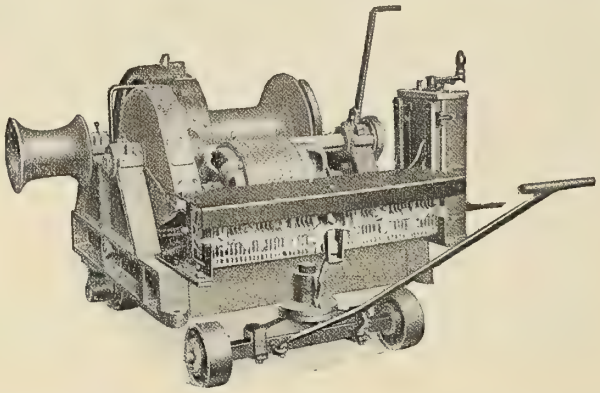
THE "MUNDY" PORTABLE WINCH

IDEAL FOR WAREHOUSES AND DOCKS



EQUIPPED WITH ROLLER BEARING WHEELS.
MAY BE EASILY MOVED BY ONE MAN.

ENTIRELY SELF-CONTAINED, HAVING MOTOR CONTROLLER AND RESISTOR ON WINCH BEDPLATE.

BUILT IN SIZES FROM 5 H. P. TO 25 H. P.
WITH SPEEDS OF 150 TO 175 FT. PER MINUTE.

CAPACITIES FROM 500 TO 5000 LBS.

STEERING ENGINES TELEMOTORS STEERING GEAR
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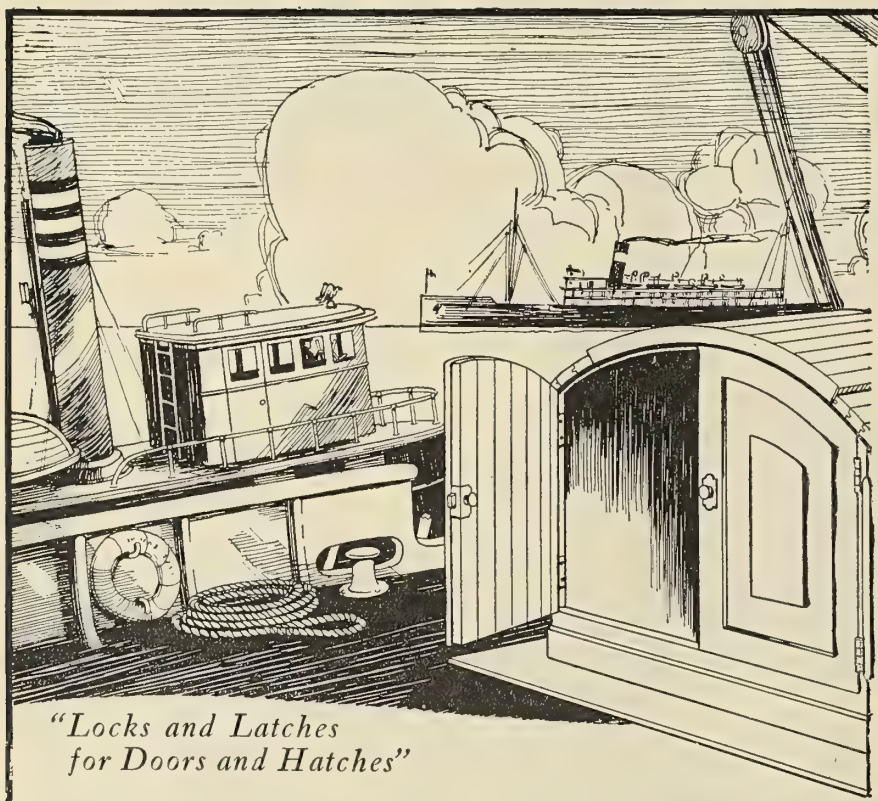
ENGINEERS *and* MANUFACTURERS Established 1869 NEWARK, N. J.



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MARINE HARDWARE

When a ship is building under contract or laid up for repairs, every hour counts.

Prompt deliveries, upon short notice, from our complete stocks, have been the means of avoiding many expensive and unnecessary delays in completing a job.

Time and tide do not wait for *Tiebout Service* — it's always there.

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Established 1853 Incorporated 1892

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THE CRANDALL ENGINEERING CO.

CONTRACTING **ENGINEERS** CONSULTING

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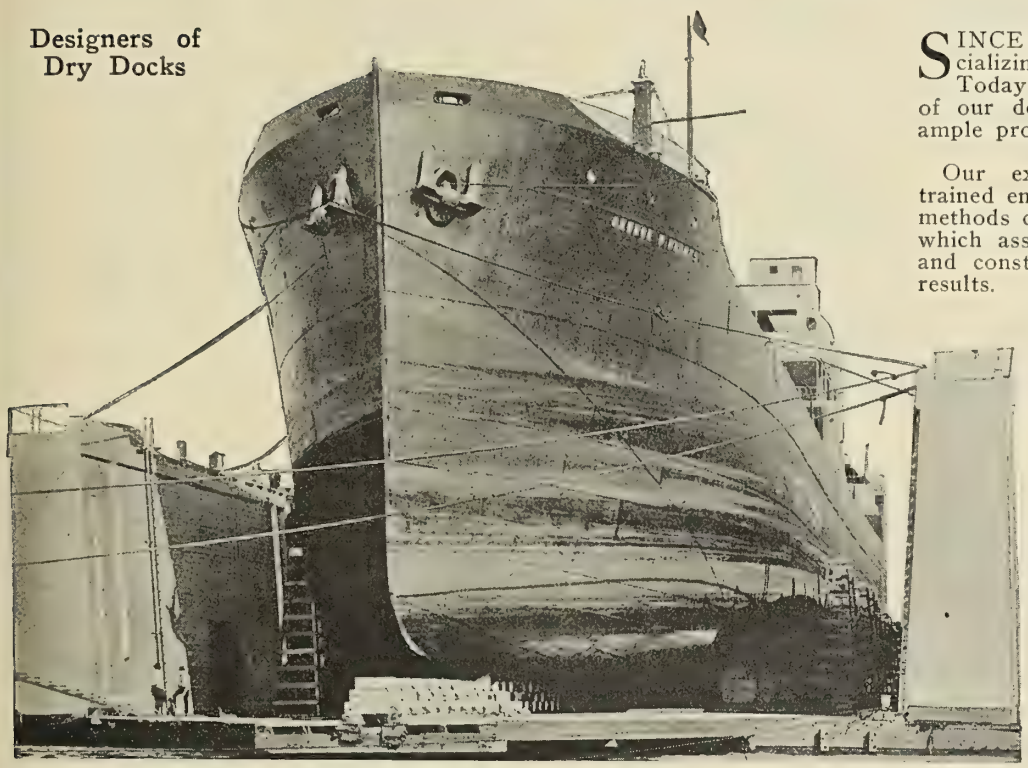
Designers of Dry Docks



SINCE 1854 we have been specializing in designing dry docks. Today more than 140 dry docks of our design are in operation—ample proof of our experience.

Our experience, our specially trained engineers, our construction methods comprise a unique service which assures economy in design and construction and certainty in results.

8000 Ton Floating Dock
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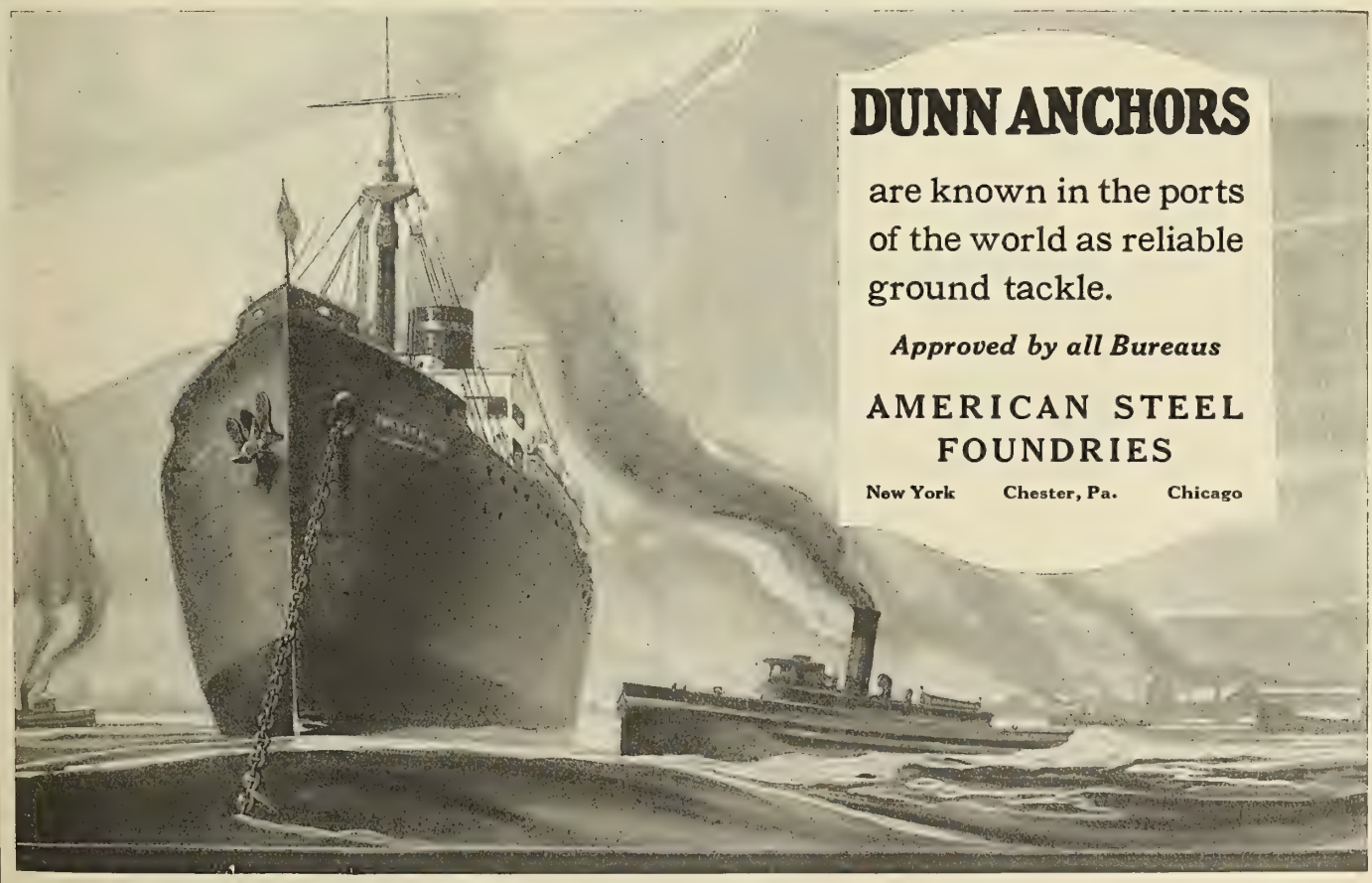

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are known in the ports of the world as reliable ground tackle.

Approved by all Bureaus

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"They all point to this symbol"

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Madesco Marine Paints and Varnishes

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What more could you desire?

P. S. THORSEN & CO., INC.

STEAM PIPE AND BOILER COVERINGS

BRINE AND COLD STORAGE WORK

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Single or Duplex

The Quality Standard

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BUFFALO OIL BURNING RIVET FORGE

Shipyards, locomotive shops, structural shops—in fact in any metal working shop where compressed air is available, the BUFFALO OIL BURNING RIVET FORGE is a valuable and desirable addition.

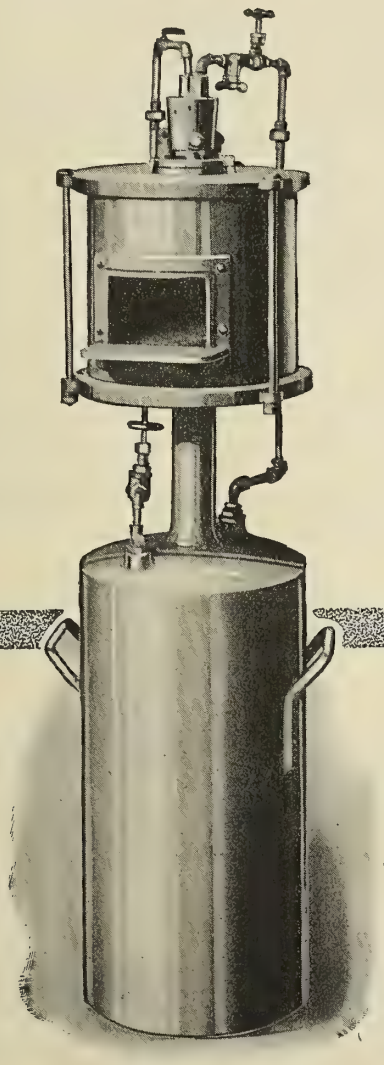
Quick firing with the possibility of burning rivets positively eliminated.

Light, strong and portable. Insures a clean fire and clean uniformly heated rivets.

Write Dept. 63 for literature.

Buffalo Forge Co.

Buffalo, N. Y.



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Shipbuilders, Engineers Boilermakers,

GOVAN GRAVING DOCK REPAIR WORKS

604 GOVAN ROAD

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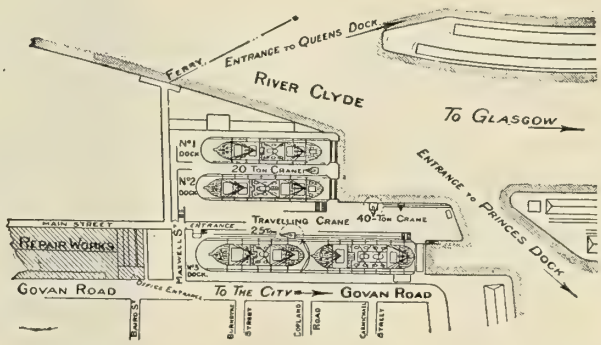
VESSELS DOCKED AND PAINTED AND REPAIRS OF ALL KINDS EXECUTED TO HULLS, MACHINERY AND BOILERS WITH UP-TO-DATE APPLIANCES, INCLUDING OXY-ACETYLENE CUTTING AND ELECTRIC WELDING PLANTS.



Office and Repair Works adjoin the Largest Graving Docks on Clyde and are conveniently situated to the Principal Discharging, Loading and Coaling Berths, thus ensuring Close Supervision and Economy of Time.

Telegrams - "MIDYARD, GLASGOW."
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Ask Any User About
their Accuracy and Dependability

Any user of S & B Gauges or "Crescent" Thermometers will tell you that he can absolutely depend upon these instruments for accuracy. They are faithful, steadfast friends that will not fail in time of need.

You can always count upon the same unchanging, uniform performance.

No ship can be run as efficiently and economically without

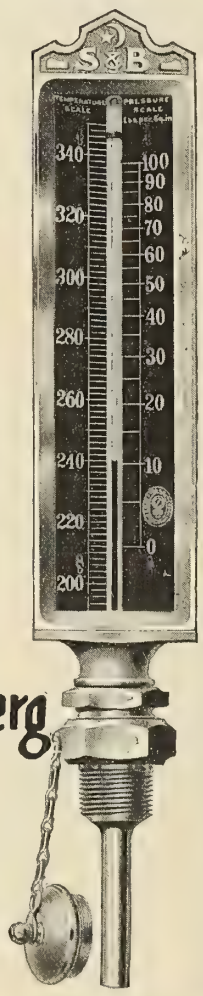
S&B Gauges
and
"Crescent" Thermometers

S & B Gauges have extra heavy, long-wearing, non-corrosive movement. Dial is hand calibrated, insuring accuracy.

Heavy black figures and graduating lines with white matt finish, which eliminates glare, make reading easy.

S & B "Crescent" Thermometers have polished brass V-shaped case with removable glass front. The scale is finished in dull black with large, easy-to-read, silvered figures and graduating lines. Tubes are of finest thermometer glass, highly magnifying.

Write for Catalogs A-23 and F-23.



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Schaeffer & Budenberg
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Makers of
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Berry & So. Fifth Sts.,
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Atlanta, Detroit, Philadelphia, San Francisco, Chicago, Los Angeles, Pittsburgh, Washington

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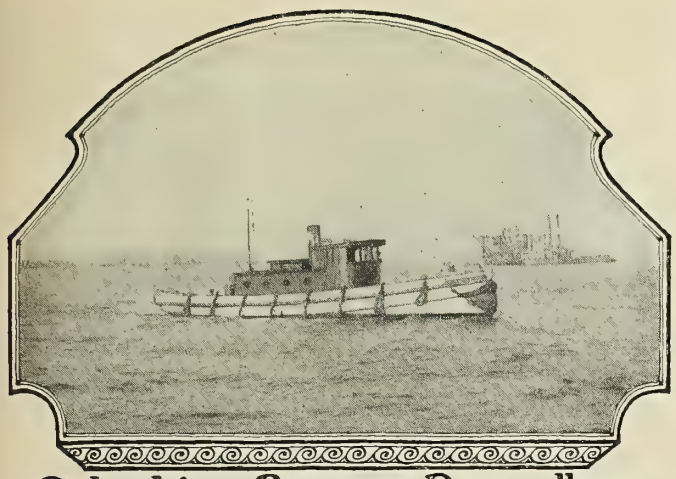
In every state in the Union, in Canada, in South America, in Europe and Asia and Africa, Norwalk compressors are in use and showing the Norwalk dependability which makes a Norwalk as safe a purchase for the compressor user in the heart of Asia as for the neighbor in Connecticut.

Illustrated Bulletins on Request

The Norwalk Iron Works Co.

Pioneer Builders of Compressors

South Norwalk, Conn.



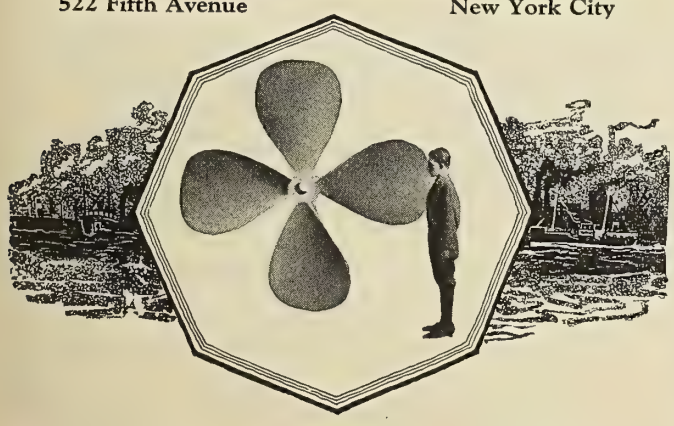
Columbian Bronze Propellers

MARY L—a Baltimore Tug powered with a 100 H. P. "CO" Fairbanks engine and equipt with a 48" x 36" Columbian Hurcules Bronze Propeller. The Fairbanks Morse & Co., recently wrote as follows:

"The Arundel Corporation's two other tugs, the "Helen W" and the "Point O Woods" are also fitted with "CO" engines and Columbian Bronze Propellers. These propellers have proven entirely satisfactory for tow boat purposes. In fact the three tow boats in general, all of which are fitted with your wheels, have proven so satisfactory that they have tied up several of their other boats (which are fitted with steam engines and cast iron wheels) due to the high operating cost of steam equipment."

Write to-day for Columbian Bronze Propeller Catalogue

COLUMBIAN BRONZE CORPORATION
522 Fifth Avenue New York City



When Time Counts and Strength and Perfect Fit are needed

reach for your

"TRADE MARK" COES
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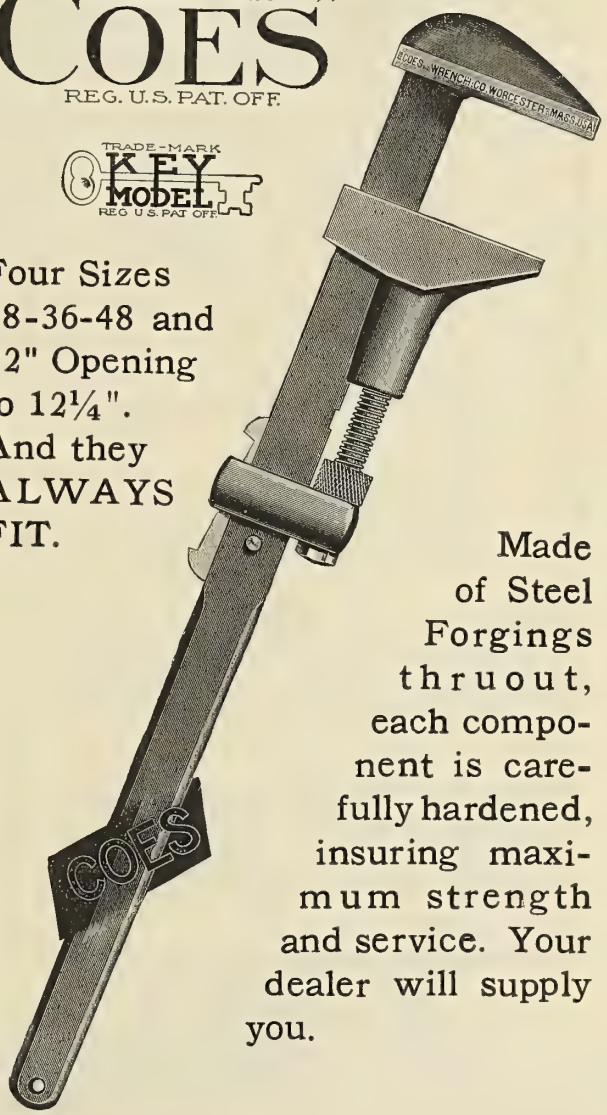
TRADE-MARK KEY MODEL REG U.S. PAT OFF.

Four Sizes 28-36-48 and 72" Opening to 12¼". And they ALWAYS FIT.



Made of Steel Forgings thruout, each component is carefully hardened, insuring maximum strength and service. Your dealer will supply you.

MADE ONLY BY

Coes Wrench Company

WORCESTER, MASS.

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A SPECIALTY FOR 76 YEARS

You are not surprised at the uniformly high quality of EMPIRE Bolts and Nuts when you know the character of the house that produces them.

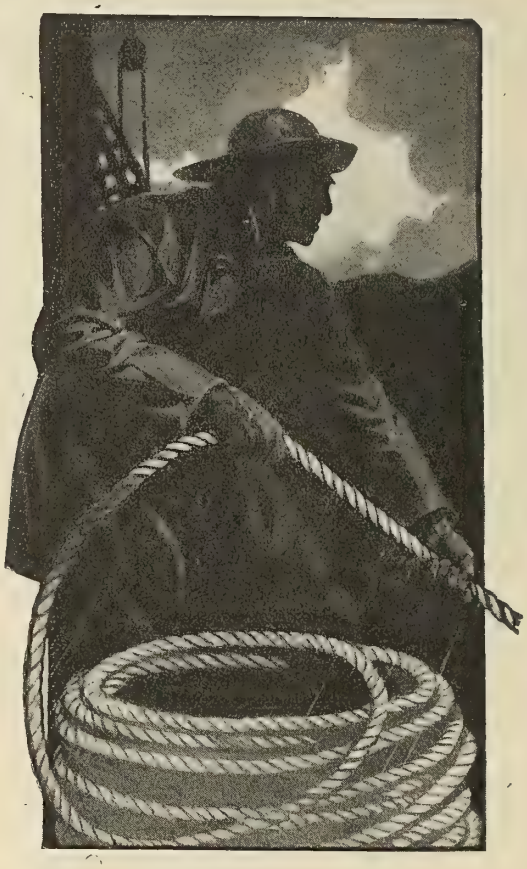
Three plants—at Port Chester, at Pemberwick and at Rock Falls—are busily engaged supplying the needs of the world's biggest industries; a privilege won by 76 years of service.

RUSSELL, BURDSALL & WARD BOLT & NUT COMPANY

PORT CHESTER, N.Y.

PEMBERWICK, CONN. · CHICAGO · SAN FRANCISCO · ROCK FALLS, ILL.

Makers of Bolts, Nuts and Rivets Since 1845



"AMERICAN" BRAND MANILA ROPE

"THE RELIABLE ROPE"

is preferred by marine men, because it is consistently good.

It gives—

"MORE VALUE IN EVERY WAY"

We also make—

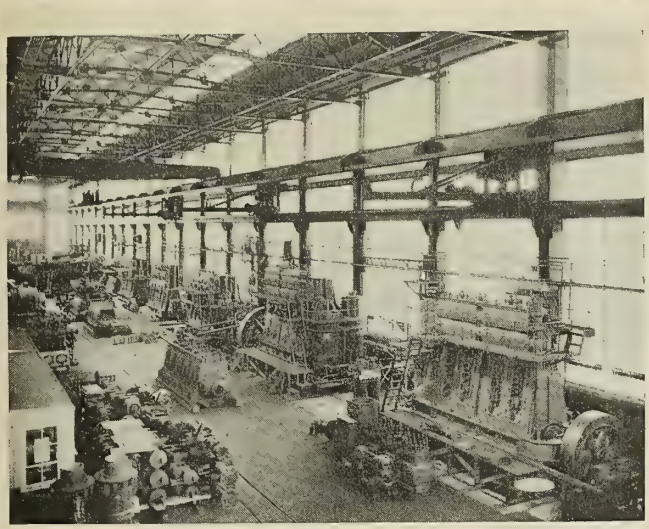
"American" No. 1 Best Marine Oakum
"That Caulking good Oakum."

AMERICAN MANUFACTURING CO.

Noble and West Streets, Brooklyn, N. Y.

Western Branch:

St. Louis Cordage Mills, St. Louis, Mo.



BUSCH-SULZER-DIESEL WORKS

OVER 25,000 B.H.P. NOW ON ORDER, INCLUDING 2-CYCLE MARINE DIESELS OF 2500 S.H.P. (SUBMARINE TYPE)

22 years of its own American experience in building over 500 Diesels, and the experience of Sulzer Bros. in building over 500,000 H. P. of 2-cycle Diesels are your assurances of ESTABLISHED DESIGN PROPER MATERIALS and WORKMANSHIP

We are prepared to build 2500 S.H.P. 4-cylinder, 2-cycle, 90 R.P.M. Commercial Marine Diesels suitable for converting steamers to single screw motorships.

Busch-Sulzer Bros.-Diesel Engine Co.

ST. LOUIS, MO.

Eastern Sales Office: 60 Broadway, New York

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Can a Barrel be Emptied through the Bunghole as quickly as it can be filled through the Open Head?

Seems like a foolish question. Yet this is the principle on which most steam taps are designed—with an opening of only ¼ in. in the discharge valve while the pipe connection has a 1½ in. hole. And then you wonder why you require such a large expensive trap to handle your condensation.

It's different with the American Ideal. Here the valve discharge orifice is much larger than in ordinary traps.

As a result, the American has a larger discharge capacity at the different pressures than any other trap having the same size inlet. Consequently you can use a smaller trap of the American Ideal *continuous flow type* than of other makes.

AMERICAN IDEAL STEAM TRAP

is the only trap with a powerful enough leverage to operate a valve with such a large orifice.

Because of this powerful leverage, we can use a heavy float, of *thicker, stronger* seamless copper which will withstand a pressure of 600 lbs. to the square inch. This heavier float eliminates the danger of the float collapsing and enables us to guarantee it for the life of the trap.

These features, and others like the reversible and renewable Monel metal valve stem, renewable phosphor bronze seat, water sealed valve, etc., make the American Ideal the most efficient and durable as well as the cheapest trap on the market.

Write for interesting booklet "A Steam Trap Catechism"

American Steam Gauge & Valve Mfg. Co.

Boston, Mass.

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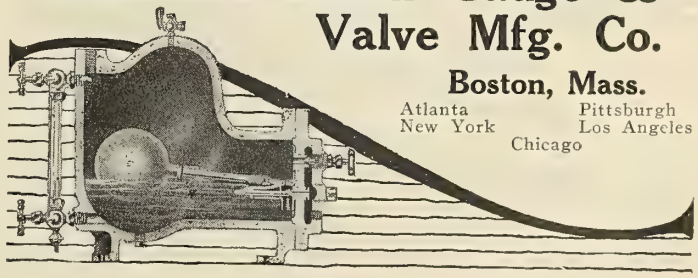


Fairbanks-Morse
"C-O" Marine Oil Engines

Three Years Ago, After Trying Two "C-O" Engines They Wrote This—

"After completing a ten days' cruise on our pilot boat "VIRGINIA" in which we have two of your 75 H.P. 'C-O' engines, we are more than satisfied with our selection—the engines functioning perfectly at all times during the delicate manoeuvring involved in boarding about three hundred vessels off the Virginia Capes and we can imagine no more severe test than this."

Now They Have Four "C-O" Engines and Write This—

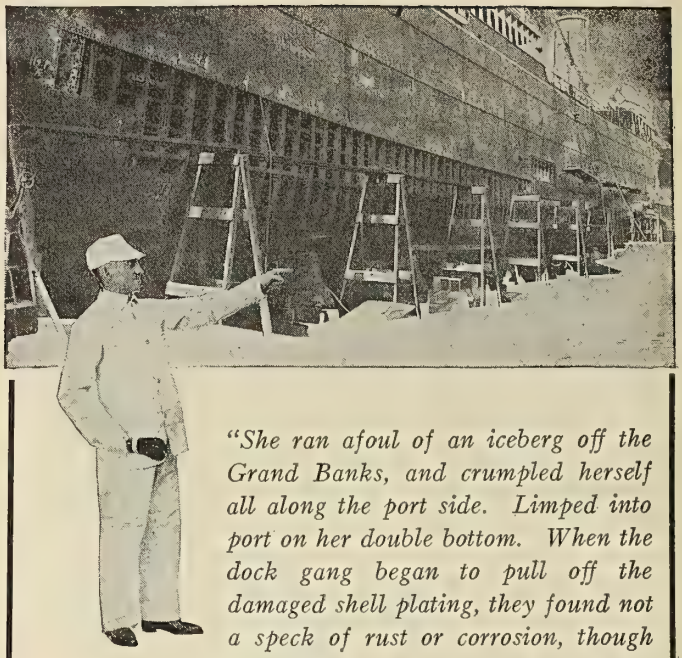
"We have previously given you as strong an endorsement as possible of the two 75 H.P.'s which you installed in our 118 ft. 'Virginia' which makes between 10 and 11 knots on a 14 ft. 6 in. draft, and we now wish to state that we are just as well pleased with the results from your engine in our 64 footer, Pilot No. 1.

"That we are more than satisfied is evidenced by the fact of our having ordered for our Pilot No. 2 another to take the place of a 120 H.P. gasolene engine. We believe the cost of operation (fuel and repairs) is something less than one-half, while the certainty of service is far ahead of the gasolene principle."

FAIRBANKS-MORSE QUALITY F M 100%

Fairbanks, Morse & Co.
MANUFACTURERS CHICAGO

Oil Engines - Pumps - Electric Motors and Generators - Fairbanks Scales - Railway Appliances - Farm Power Machinery



"She ran afoul of an iceberg off the Grand Banks, and crumpled herself all along the port side. Limped into port on her double bottom. When the dock gang began to pull off the damaged shell plating, they found not a speck of rust or corrosion, though 'tis goin' on ten year since we gave her a coating of Briggs."

—"Bituminous Bill"

BRIGGS
Bituminous Compositions

offer safe and certain protection to ships' inner plating and all the hidden, out-of-the-way nooks and corners of the double bottom, where rust and corrosion would otherwise gain a dangerous foothold.

They form a tough, elastic, impermeable film which will neither chip nor crack, and which resists the attacks of the elements, sulphurous fumes, alkalies and acids.

You will find much useful information in our catalog, "The Solution of the Corrosion Problem" —shall we send you a copy?

Briggs Bituminous Composition Co., Inc.
17 Battery Place **New York**

Great Britain: Wm. Briggs & Sons, Ltd., Dundee, Scotland

BBC-31

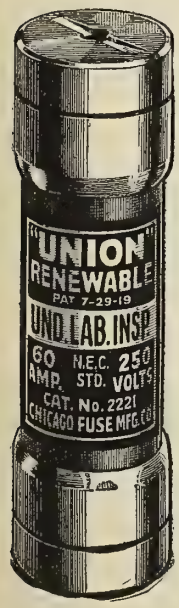
BRIGGS **BITUMINOUS COATINGS**
The Solution of the Corrosion Problem

WHY "UNION" RENEWABLE FUSES *Don't Get Hot*

Heat is caused by resistance. Consequently the more metal there is to carry the current in a fuse, the less resistance—less heat—there will be.

Compare the weight of the metal in a "Union" Renewable Fuse with others. You will find *more* solid brass in *one* of the caps of a "Union" Renewable Fuse than there is on both caps of some fuses.

Brass costs real money these days. And we could save a great deal of money by skimping on the weight of our metal parts. But that is not the "Union" way of building fuses. Every part of "Union" Fuses is of the most rugged construction. They are built to give *perfect* service and *long* service.



"Union" Fuses, both Renewable and Non-Renewable, are for sale by all leading electrical jobbers and dealers.

They are approved in the very highest degree by the National Board of Fire Underwriters.

Free descriptive booklet sent on request.

Saves more than ANY other Renewable Fuse

Chicago Fuse Mfg. Co.

Oldest and largest manufacturers of Fuses, Electrical Protecting Materials and Conduit Fittings.

Chicago New York

The R & D PARACOIL Feed Water Heater

Constructed with cast iron or steel plate shells, with coils of a very high thermal efficiency. Improved cleaning facilities make maintenance expense low.

Write for catalogue and complete information.

Row & Davis Engineers, Inc.

Consulting and Contracting Engineers

Evaporators, Feed Water Filters, Grease Extractors, Distillers, Ash Ejectors, Condensers, Fresh Water Stills, Fuel Oil Heaters, Oil Coolers, R & D Gravity Flow Filters and Inspection Tanks, RanD System for Bunker Oil.

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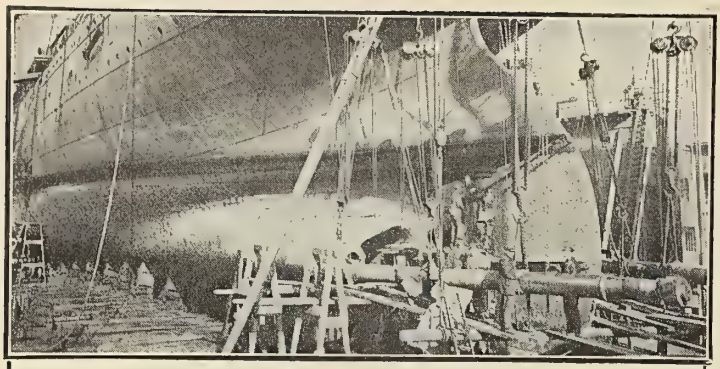

From Keel to Load Line Protect the Hull with

FEDERAL BOTTOM COMPOSITIONS

—and from the load line up, wherever wood or metal is exposed to the action of the elements, some others of the complete line of Federal Marine Paints and Compositions.

There's a Federal Paint for Every Marine Purpose

—Bottom Composition for steel or iron hulls—Boottopping Compositions—Topside Paints—Deck Paints—Deck House Paints —Smokestack Paints, Sundry Paints, for masts, bulwarks, ventilators, etc.—Engine Room Paint, Cabin Paints, Hold Enamels, etc.

Owners and captains the world over know that one good painting with Federal is far more economical than frequent paintings and repaintings with an inferior product.

Specify Federal—or allow us to estimate on your painting and cleaning. Descriptive folder and color card on request—address nearest office.

The Federal Composition and Paint Co.,
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Philadelphia	Pensacola	Seattle
Baltimore	Jacksonville	San Francisco
Newport News	Tampa	Los Angeles
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Great Britain: The British Anti-Fouling Composition & Paint Co., Ltd.
130 Fenchurch St., London, E. C. 3

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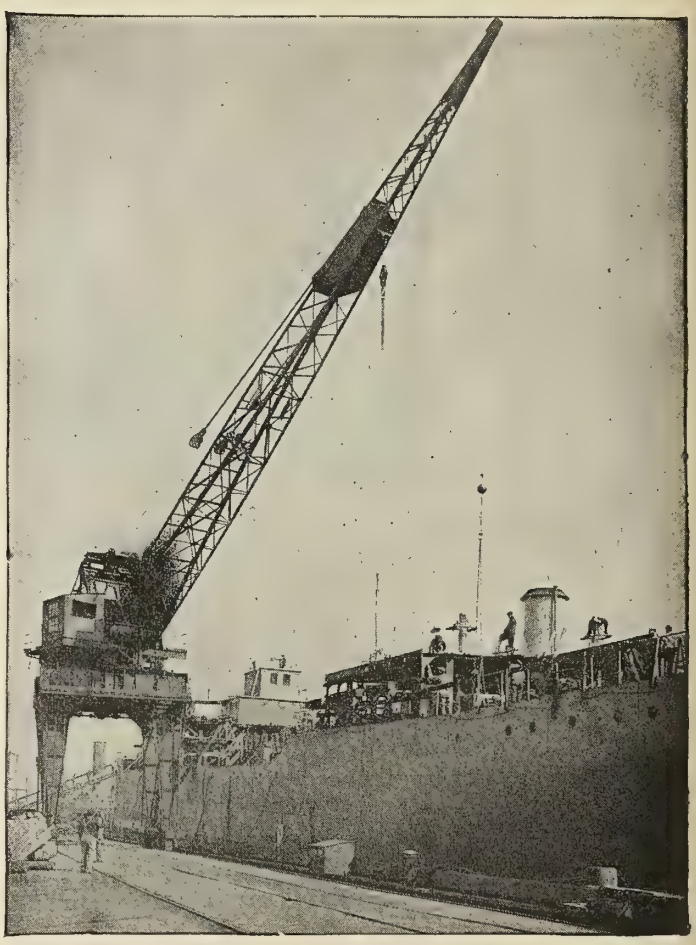
TRADE-MARK

FEDERAL MARINE PAINTS
"Weather-best"



BROWNHOIST

Makes Freight Handling Easy

This big Brownhoist Portal Pier type Locomotive Crane will toy with most bulk and package cargoes which sometimes cause so much trouble in unloading. With its long, high boom it will reach any point on the ship, doing its work rapidly and with no confusion. Or with the auxiliary hoist, it has the titanic strength to lift packages weighing tons and to place them wherever you may choose.

The portal pier is made to span one or more railroad tracks and the cargo may be loaded into the waiting cars or placed in the near-by warehouses. It is a very useful machine about which you should know more. Write for catalog K.

The Brown Hoisting Machinery Company

40 Years in Crane Business — **Cleveland, Ohio, U. S. A.**

Engineers and Manufacturers of Heavy Dock Machinery, Bridge Cranes, Etc., as well as Smaller Cranes and Hoists.

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"It's a pleasure to operate this machine"

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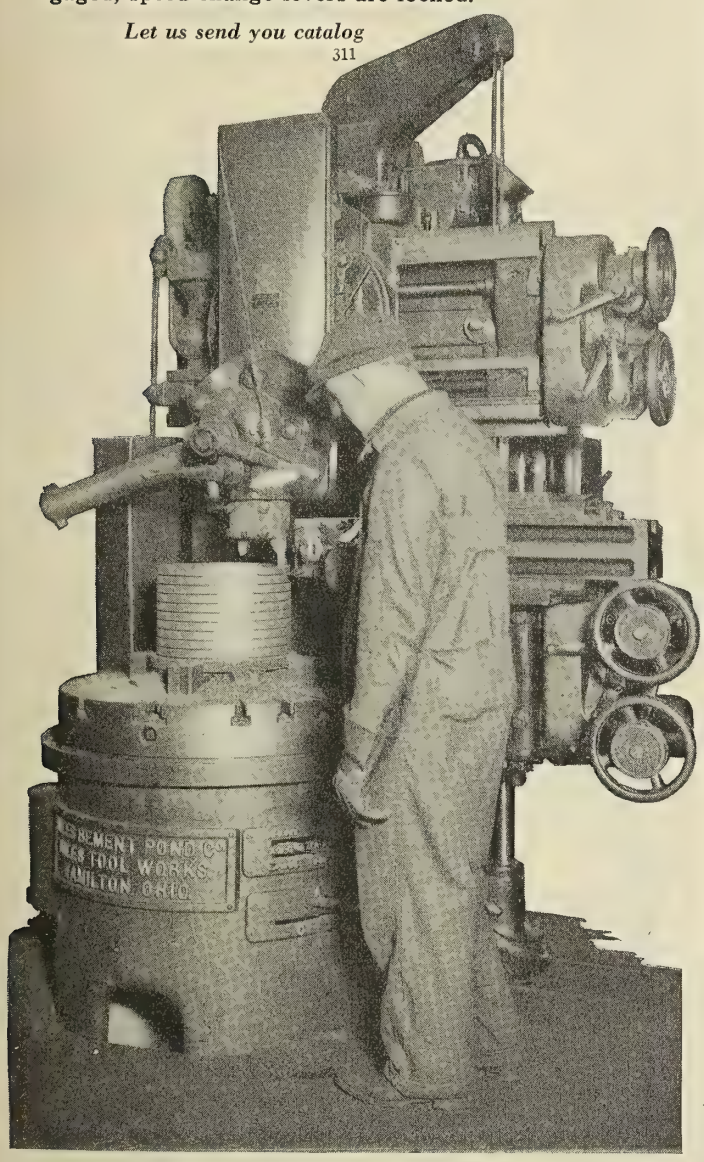

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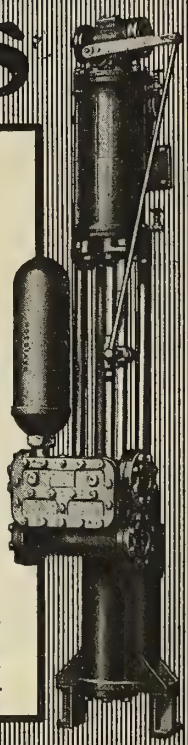

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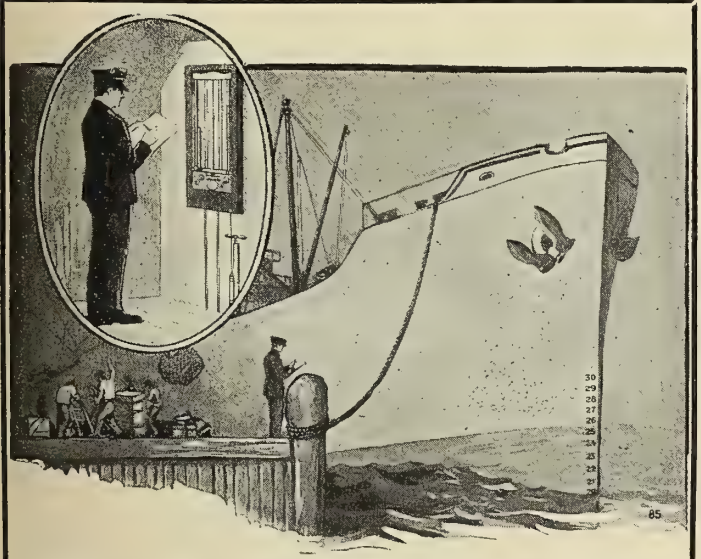

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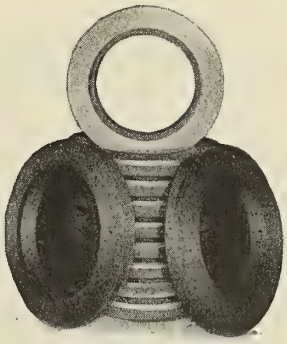

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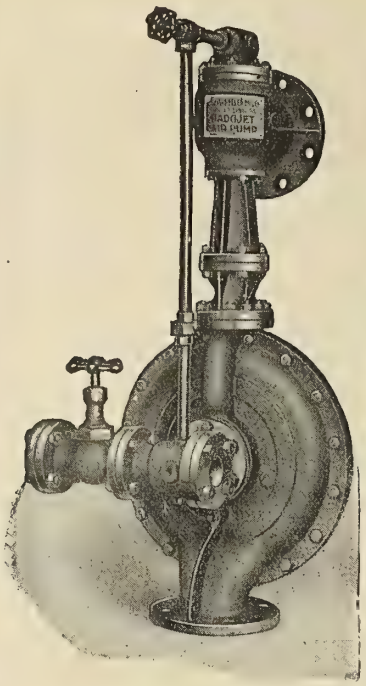

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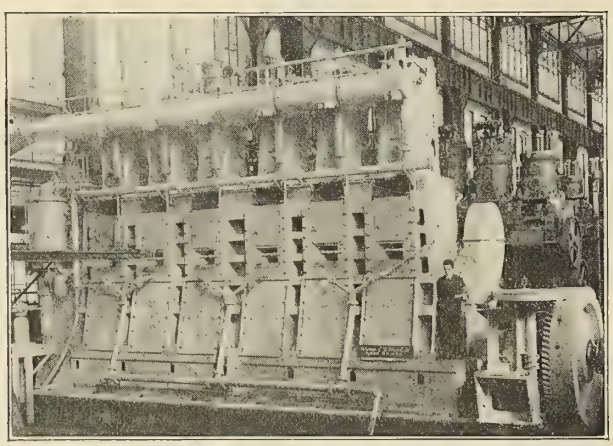

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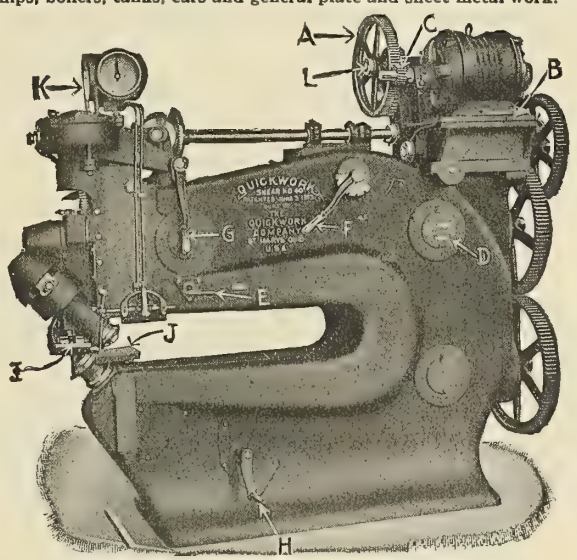

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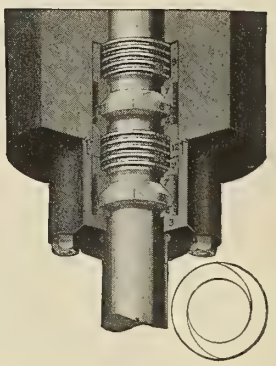

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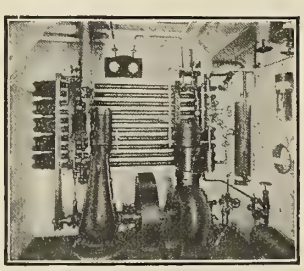

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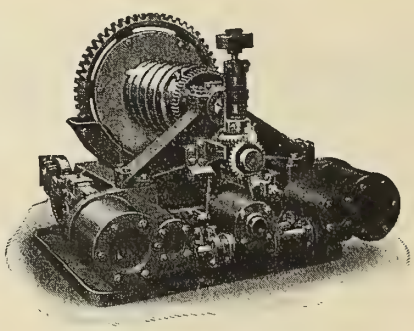

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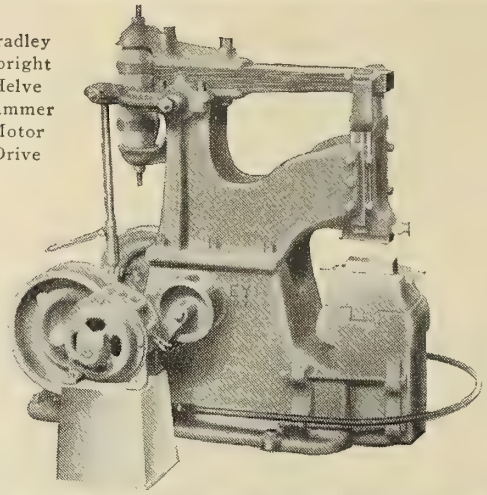

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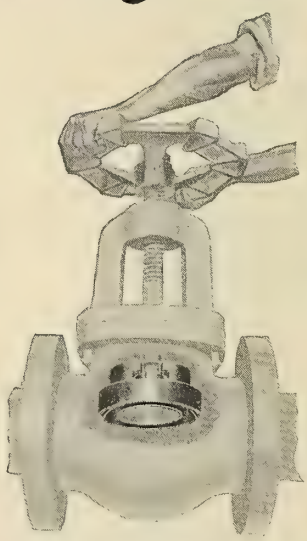

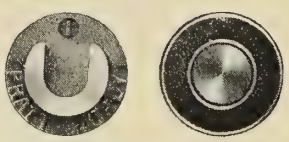

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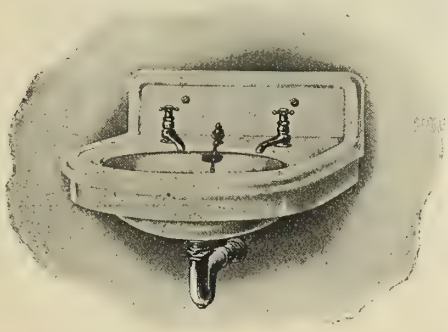

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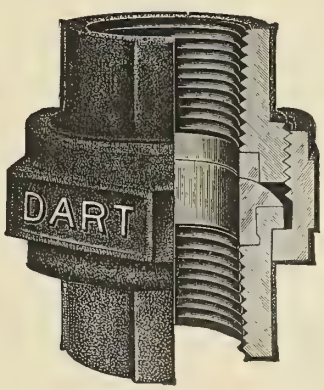

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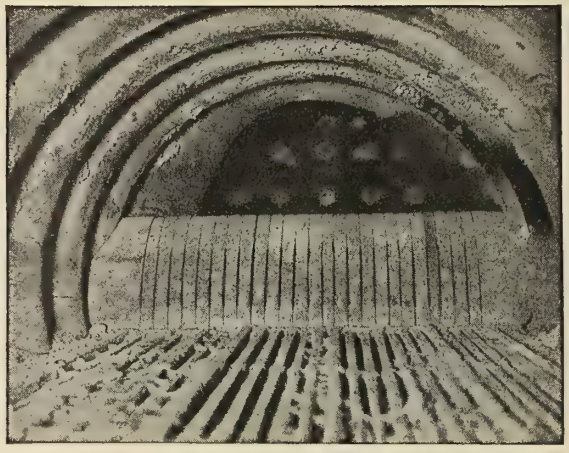

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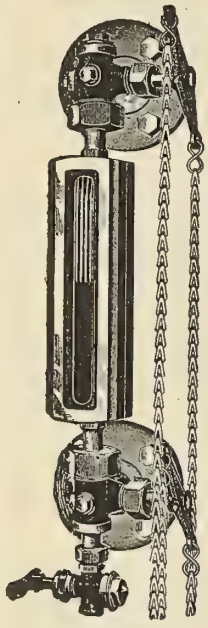

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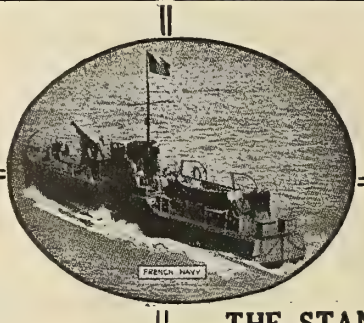

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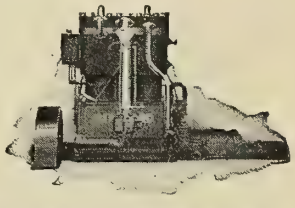

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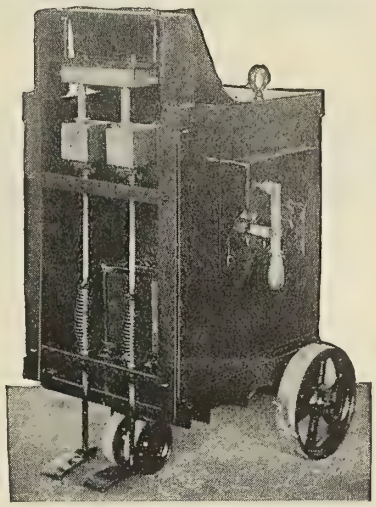
THE TAYLOR VALVELESS AUTOMATIC SELF-CLEANING ATOMIZER MARINE OIL ENGINES

For CRUDE OIL FUEL OIL
KEROSENE

Sizes from 25 to 2000 H.P.

Built For Service



Model I—Type C-2—Electric Forge

Industrial and Structural Electric Rivet Heating Forges are manufactured as follows:

Rivets diameter.

Model I—Type A-2—¼ to ½"—6" long.
Model I—Type B-2—½ to ¾"—6" long.
Model I—Type C-2—¾ to 1½"—6" long.

Model S—Type for construction work small and compact. Same type as the Industrial Forge without wheels.

We will be glad to quote prices on any devices for special heating purposes, at any time. Our engineers will help solve your heating problems upon request, for annealing, hardening, welding, blacksmithing.

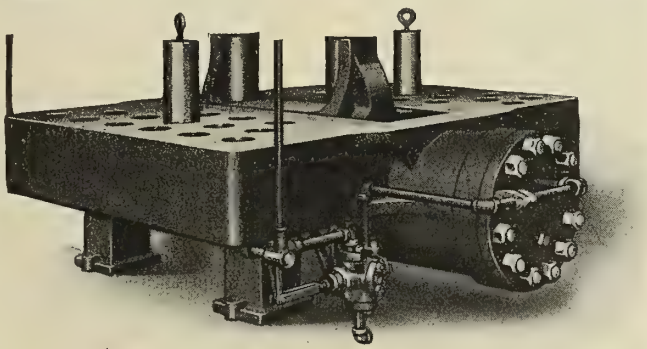
QUALITY PROMPTNESS SERVICE

Patented and Manufactured by

The United States Electric Co.,
New London, Conn.

Hydraulic Machinery

We show here *just* one example from our large line of presses for Bending Pipe, Rods, Shafts, Angles, Beams and Structural Shapes, etc.



This machine works on water pressure of 1500 lbs. per square inch. The pins are interchangeable in any of the holes. The ram is double ended and is actuated by two cylinders, enabling the operator to exert force from either side of the table. The valves are placed in one body, and connecting levers at either side of the press govern the movements completely.

We build hydraulic presses for every purpose where hydraulic pressure is a possibility—also pumps, accumulators, valves, fittings, packings, shears, riveters, punches, jacks, etc.

THE WATSON-STILLMAN CO.
36 Church St., New York
Chicago, McCormick Bldg.
Philadelphia, Widener Bldg.

Wilmer H. Johnson, President; Ellis J. Stearns, Sec'y-Treasurer; Warren Johnson, V. P. & Gen. Mgr.; Eads Johnson, V. P., 115 Broadway, New York.

JOHNSON IRON WORKS
DRY DOCK & SHIPBUILDING CO., INC.

Operating

DRY DOCKS 5,000, 2,000, 250 tons Cap.

and

MARINE REPAIR PLANT

Algiers Station

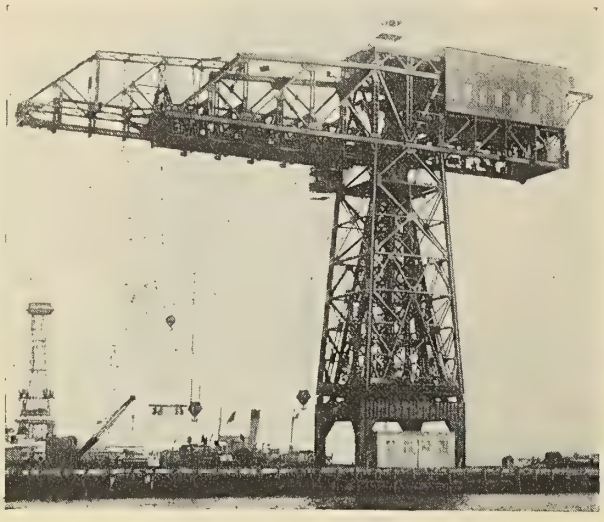
Construction Yard, Bayou St. John

Builders of

Tugs, Barges and River Steamboats

New Orleans, Louisiana

The Largest Shipbuilding Crane



This crane is in the League Island Navy Yard, Philadelphia, and has an operating capacity of 350 gross tons at 115 ft. radius. Our success in designing and building this unusual crane should inspire your confidence in our ability.

We also manufacture Locomotive Cranes, Clam Shell Buckets, Coal and Ore Handling Machinery, Car Dumpers, Pile Drivers, Derrick Cars and a complete line of Shipbuilding Machinery consisting of Gantry Cranes, Bridge Cranes, Hammerhead Cranes, both of the stationary and traveling type. **Consult us when in the market.**

The McMyler Interstate Co., Cleveland, Ohio

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Chicago, Illinois, 812 Edison Building.
Seattle, Washington, Hoge Building.
Denver, Colorado, 18th and Wazee Streets.
San Francisco, California, 766 Folsom Street.
Birmingham, Alabama, Brown-Marx Building. SB-25

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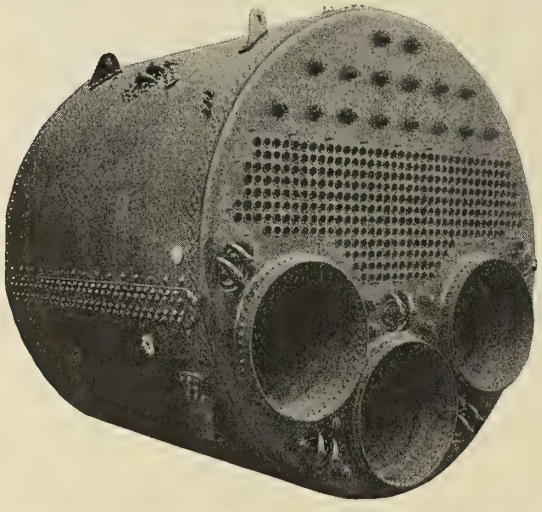
12-SCOTCH BOILERS

14'3½" ID. x 11'6" LONG

180 lbs. WP-2550 Sq. Ft. H.S.

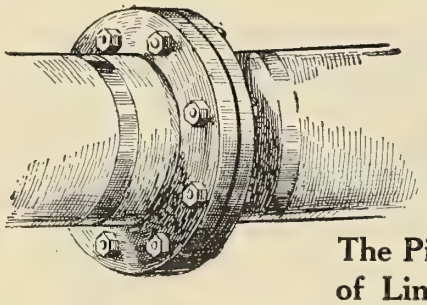
COMPLETE WITH ALL FITTINGS

WRITE FOR INFORMATION



VULCAN IRON WORKS, Inc.

JERSEY CITY, N. J.



The Pipe Is Out of Line — BUT

The GOETZE GASKET Is Holding Tight

Even if the pressure is high with a poor job in pipe fitting you can make any joint tight with a Goetze Gasket.

The resilient deep corrugation in the copper or other metal and the spun asbestos rings take care of that. They remain in perfect contact with the flange surface, regardless of expansion and contraction.

Goetze Gaskets last as long as the pipe line. You can remove them and re-use them with assured tightness.

We are ready now to convince you that Goetze Gaskets, Goetzerit Sheet Packing and Goetze Valve Discs are unbeatable in any service. A 90 days' free trial allowed.

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SHIPBUILDERS AND ENGINEERS

LOS ANGELES HARBOR
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NEW 12,000 TON DRY DOCK NOW IN SERVICE
UNLIMITED FACILITIES FOR MARINE REPAIRS TO STEEL AND WOOD VESSELS

DESIGNERS AND BUILDERS OF ALL TYPES OF STEEL SHIPS, MARINE ENGINES & AUXILIARIES.

SIX BUILDING SLIPS
LAUNCH AND TUG BOAT SERVICE

Tug "Rahada"

S.S. "West Columbia"

3500 I.H.P. Marine Engine

The Baltimore Dry Docks & Ship Building Co.

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Ship Repairs

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BITUMINOUS COATINGS
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Bilges, Tank Tops, Coal Bunkers, Inner Bottom
Tanks, Floors, Peaks, Refrigerating Spaces

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FORMERLY
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17 BATTERY PLACE, NEW YORK

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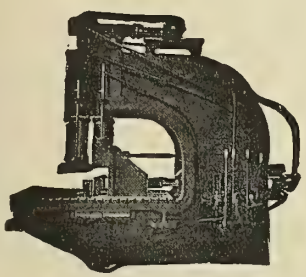
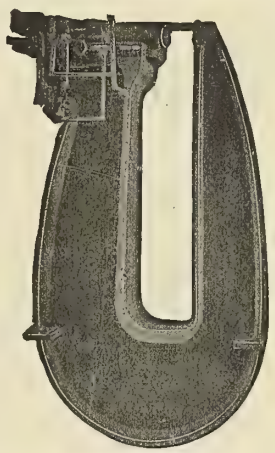


CHAMBERSBURG
HYDRAULIC
MACHINERY

Steam Hydraulic Forging Presses Hydraulic Riveters
Flanging Presses Accumulators Cranes Pumps

STEAM HAMMERS
STEAM DROP HAMMERS, BOARD DROP HAMMERS
CHAMBERSBURG ENGINEERING CO.
Chambersburg, Penna.
SEND FOR CATALOG



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Have given over 30 years' satisfaction
to the largest shipbuilders in America.

Heavy Plate Work of every description.

Estimates furnished—no obligation.

LAKE ERIE BOILER WORKS BUFFALO, N. Y.

MENGE MARINE-HARDWARE & SUPPLY CO., Inc.

SHIP CHANDLERY

Deck, Engine, Cabin Stores and Fresh Provisions

We carry in stock everything used for building, repairing and provisioning vessels

DISTRIBUTORS *Phones Main 861-862* *Cable Address, "Menge"*

WHITLOCK MANILA ROPE **218-232 Canal Street, New Orleans, La.**

CHARLESTON DRY DOCK AND MACHINE CO.

SUCCESSORS TO

VALK & MURDOCH

CHARLESTON, S. C.

Builders of Marine Boilers, Scows and Lighters

8,000-Ton Floating Drydock	1,500-Ton Marine Ry.	500-Ton Marine Ry.
Length on Blocks 440′	Length on Blocks 220′	Length on Blocks 100′
Depth over sill 22′	Depth over Blocks 14′	Depth over Blocks 7′

Marine Repairs a Specialty

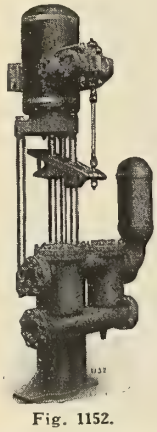


Fig. 1152.

IS THIS YOUR SHIP?

MARINE DISASTERS.

Name of Vessel	*Date*	*Nature*	*Place*	*Damage Resulting*
John Doe	June 1	Disabled	At sea	PUMP TROUBLE

Probably not:—In that case, Good!

Frequent notices like the above show well that too little attention is paid to the selection of marine pumping equipment.

Why not remove all possibility of such trouble?

TRANSIT MARINE PUMPS

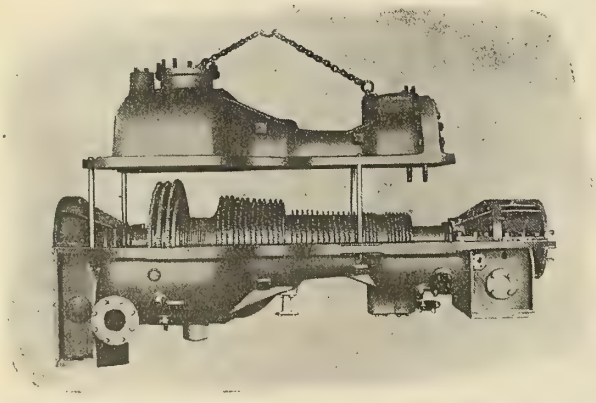
will do it.

The illustration shows our Marine Boiler Feed Pump, designed and built to pump water into boilers. It does this **every time** the steam is turned on.

NATIONAL TRANSIT PUMP & MACHINE COMPANY

OIL CITY, PA.

District Offices: New York Pittsburgh Kansas City Philadelphia Cleveland Houston Denver



BARGAIN

PARSONS MARINE STEAM TURBINES

AT ½ PRICE

FOR QUICK SALE

3 cross compound turbines 2500, 2800 and 3000 S.H.P. New and latest design.

HALLIDIE CO., Spokane, Wash.

USED MARINE EQUIPMENT

Classified Advertisements—Help and Situation Wanted advertisements appearing in the "Get Together Department," 5c. a word an insertion. Minimum charge $1.00 for each insertion. For Sale advertisements $6.00 a column inch (1" by 3½" wide). Any number of inches may be used. Copy must be in this office by the 10th of each month preceding to insure insertion in the issue.

POSITIONS WANTED

POSITION Wanted, General Manager or Works Manager. Have had 20 years' experience in Shipbuilding and Managing Shipyards. Have been very successful in reducing cost of construction and in handling labor. Address Box No. 61, care Marine Engineering.

HULL draftsman, 9 years' shipbuilding experience, drawing room and mould loft, desires position, any capacity. Box No. 76, care Marine Engineering.

MARINE Engineer and Ship Surveyor, age 42, at present with Classification Society, desires position with consulting engineer, ship repair or building concern, port engineer with shipping company, or other connection where the practical experience of a lifetime could be used to advantage. Write for data and references. Address Box No. 72, care Marine Engineering.

POSITIONS WANTED

MARINE Superintendent, 20 years' experience, both new new ship work and general repair work, has wide experience in esimating on all kind of repair work, will accept foremanship position, go anywhere, speak French and Epanish. Address Box No. 73, care Marine Engineering.

A LIVE-WIRE, pre-war hull man, technical education (13 years' experience and specialist on water and oil-tight work), is open for position on new or repair work. Have following of best mechanics if desired. Ability to handle men and can get out the work vouched for through references and demonstrated by me. Box No. 74, care Marine Engineering.

Let us help you find the right man or position.
A "Want Ad" on this page
BRINGS RESULTS.

BUYING A PIG IN A POKE

The buying of advertising space used to be buying "a pig in a poke." The quantity and quality of circulation was shrouded in mystery and often the bag was tied against investigation.

That day has passed. The Advertiser no longer depends upon "mere claims." The Audit Bureau of Circulations has untied the strings to the sack and the circulation of the better class of publications is thrown open for the most searching scrutiny.

In buying advertising space in **MARINE ENGINEERING** you are not buying "a pig in a poke." Our A. B. C. statements will stand the analysis of the most exacting investigator.

FOR SALE
MARINE ENGINES FOR SALE

ONE (1)—25 H.P. BOLINDERS Single Cylinder Stationary Heavy Oil Engine, Model BII, capable of continuous overload, coefficient of fluctuation 1 in 70 for power service. Engine complete with pulley and complete system of automatic self-starting.

ONE (1)—24 H.P. SKANDIA Vertical Single Cylinder Stationary Oil Engine. 375 R.P.M. Complete with driving pulley, air tank for starting, numerous accessories and spare parts.

ONE (1)—30 H.P. GULOWSEN GREI Marine Engine, type GB2G Two Cylinder Vertical 460 R.P.M., with all equipment, except thrust bearing, reverse gear, clutch and propeller.

The above engines are practically new and in first-class condition. Prices about one-half of current market, f. o. b. East Cambridge, Mass. Immediate shipment.

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is the show window for advertisers who have second-hand equipment for sale—Try it.

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CONSULTING AND MARINE ENGINEERS, NAVAL ARCHITECTS MARINE SURVEYORS, PATENT ATTORNEYS, ETC.

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Designers and installers of Automatic Fire Alarms for both Marine and Land service.

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ENGINEER TO

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NEW YORK ENGINE COMPANY

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Plans and Specifications furnished for seagoing and inland waterway types of commercial vessels. Also for steam and sailing yachts and motor boats.

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Bituminous Coatings
Briggs Bituminous Composition Co., Inc.
Wailes Dove-Hermiston Corp.

Blocks
(See Chain Hoists and Blocks; also Tackle Blocks)
Union Hardware Co.

Blowers
(Also see Soot Blowers)
Buffalo Forge Co.
De Laval Steam Turbine Co.
General Electric Co.
Kearfott Engineering Co.
Kerr Turbine Co.
Westinghouse Electric & Mfg. Co.

Blow-Off Valves
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady Co., Inc.
Williams, Wm. E.

Boat Accessories
American Balsa Co.
Sands, A. B., & Son Co.
Steward Davit & Equip. Corp.
Williams, Wm. E.

Boat Builders
(See Launches and Yachts)

Boat Davits
(See Davits).

Boat Fittings
Sands, A. B., & Son, Co.
Tiebout, W. & J.
Williams, Wm. E.

Boat Nails
Williams, Wm. E.

Boats
(See Life Boats; also Launches and Yachts)

Boiler Braces
Lukens Steel Co.

Boilers
Babcock & Wilcox Co.
Baltimore Dry Docks & Shipbuilding Co.
Bath Iron Works.
Bethlehem Shipbuilding Corp.
Charleston Dry Dock & Machine Co.
Consolidated Shipbuilding Corp.
Foster Marine Boiler Corp.
Heine Safety Boiler Co.
Hyde Windlass Co.
Johnson Iron Works, Ltd.
Kearfott Engineering Co.
Lake Erie Boiler Works.
New York Engineering Co.
Staten Island Shipbuilding Co.
Vulcan Iron Works, Inc.
Ward, Charles, Eng. Works.

Boiler Compounds
Waycott, A. K.

Boiler Coverings
(See Non-Conducting Coverings)

Boiler Expanders
Watson-Stillman Co.
Williams, Wm. E.

Boiler Feeders
(See Feed-water Regulators)

Boiler Feed Pumps
(See Pumps)
Alberger Pump & Condenser Co.
Davidson Co., M. T.
De Laval Steam Turbine Co.
Ingersoll-Rand Co.
Kerr Turbine Co.
Warren Steam Pump Co.
Williams, Wm. E.

Boiler Flue Cleaners
The Diamond Power Specialty Co.
Maritime Engineering & Sales Corp.
Williams, Wm. E.

Boiler Gauge Glasses
(See Gauge Glasses)

Boiler Heads
Lukens Steel Co.

Boiler Makers' Test Pumps
(See Test Pumps)

SUN OILS

Good Ships Deserve Viking Marine Engine Oil

VIKING Marine Engine Oil — for thrust bearing and reciprocating engine lubrication—is the latest development among the Sun Marine Oils. It conforms in efficiency with the high standards maintained for years in the famous Sun XX Marine Oil.

Viking Engine Oil, by reason of a special patented refining process, will form a perfect and lasting emulsion with either salt or fresh water.

The body of this emulsion may be varied from a heavy pastelike substance to any consistency by the simple addition of a larger percentage of water.

For lubrication of thrust bearings an emulsion of Viking Oil with from 50 to 75 per cent water is recommended.

When used for main bearings without the addition of water, Viking Oil has high viscosity and extremely low internal frictional values. It will absorb any water that may find its way into the bearings and will feed indefinitely through a wick without clogging the pores.

Although having the saponifiable value of oils highly compounded with blown rape seed, Viking Marine Engine Oil will not deteriorate and become rancid with age.

In addition, Viking Oil is neutral in reaction and contains no fatty acids, thus eliminating the corrosion of metal parts produced by the high acid content of most marine oils. It is unaffected by low temperatures.

The Sun Company is one of the world's largest producers, refiners and shippers of petroleum products. Its output of lubricating oils alone exceeds a million and a half gallons per week.

The Sun Company has specialized for a quarter century in lubricating oils. It has developed into an organization of lubrication experts, its aim being to supply accurate and efficient lubrication instead of just "oil".

The choice of a lubricant for any particular purpose demands expert advice. Engineers of the Sun Company are available to make an analysis of your lubrication requirements and specify the right oils to meet them. This service is free.

SUN COMPANY

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Branch Offices and Warehouses in 30 Principal Cities

Stocks Carried at

Atlanta Baltimore Boston Buffalo Chicago Cincinnati Detroit Minneapolis Newark New Orleans Newport News New York City Philadelphia Pittsburgh Sabine St. Louis Toledo

Boiler Nozzles, Welded Steel
Continental Iron Works, The

Boiler Plates
(See Steel Plates)

Boiler Rivets
(See Rivets)

Boiler Riveters
(See Power Riveters)

Boiler Room Fittings
Ashton Valve Co.
Crane Co., The
Jerguson Gage & Valve Co.
Kearfott Engineering Co.
Lunkenheimer Co., The
Powell Co., The William
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Boiler Staybolts
(See Staybolts)

Boiler, Steam and Water Drums, Welded
Continental Iron Works, The

Boiler Tube Retarders
Williams, Wm. E.

Boiler Tubes
Kearfott Engineering Co.
National Tube Co.
Parkesburg Iron Co.
Williams, Wm. E.

Bolts and Nuts
Russell, Burdsall & Ward Bolt & Nut Co.
Williams, Wm. E.

Booms—Tubular Steel
National Tube Co.

Boring Bars
(See Cylinder Boring Bars)

Boring Machines—Metal Working
Ingersoll-Rand Co.
Niles-Bement-Pond Co.

Boring Machines—Wood
Chicago Pneumatic Tool Co.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

Boring and Turning Mills
Niles-Bement-Pond Co.

Brass and Copper
Chase Metal Works
Chase Rolling Mill Co.
Sands, A. B., & Son Co.
Williams, Wm. E.

Brass Castings
(See Castings—Brass)

Brass Fittings
Ashton Valve Co.
Chase Rolling Mill Co.
Crane Company, The
Lunkenheimer Co., The
Powell Co., The William
Sands, A. B. & Sons Co.
Tiebout, W. & J.
Williams, Wm. E.

Brick
(See Fire Brick)

Bridge Control
Westinghouse Electric & Mfg. Co.

Bridge Walls
(See Furnace Bridge Walls)

Brokers
(See Ship Brokers)

Bronze
American Manganese Bronze Co.
Chase Metal Works
Chase Rolling Mill Co.
Columbian Bronze Corp.
Crane Co.
Lunkenheimer Co.
Powell Co., The William
Williams, Wm. E.

Bunks
Southern-Rome Co.

Buoys
Williams, Wm. E.

Buoys, Ring
Williams, Wm. E.

Burners, Fuel Oil
(See Fuel Oil Burners)

Bushings
Crane Co., The
Lunkenheimer Co., The
Williams, Wm. E.

By-Pass Valves
Crane Co., The
Griscom-Russell Co.
Lunkenheimer Co., The
Powell Co., The William

Cables
(See Chain; also Rope)
National Malleable Castings Co.

Cableways
(See Marine Cableways)

Caliper Gauges
Williams & Co., J. H.

Calking Machinery
Ingersoll-Rand Co.

Calking Tools
Williams, Wm. E.

Calorimeters
Schaeffer & Budenburg Mfg. Co.

Cam Shafts
Pollak Steel Co.

Canvas
Williams, Wm. E.

Capstans
(Steam, Electric, Hand)
Allan-Cunningham Co.
American Engineering Co.
Bethlehem Shipbldg. Corp.
Flory, S., Mfg. Co.
Hadfield-Penfield Steel Co.
Hyde Windlass Co.
Maritime Engineering & Sales Corp.
Mundy Hoisting Engine Co.
Williams, Wm. E.

Carbon Dioxide Valves and Fittings
Frick Co.
York Manufacturing Co.

Carbon Dioxide Machine
Frick Co.
York Manufacturing Co.

Car Dumpers
Brown Hoisting Machinery Co.
McMyler Interstate Co.

Cargo Hoists
(See Hoisting Engines)

Cargo Lights
General Electric Co.
Williams, Wm. E.

Cargo Winches
(See Winches)

Castings—Aluminum
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co., The
Powell Co., The William
Sands, A. B., & Son Co.

Castings—Brass
Charleston Dry Dock & Machine Co.
Crane Co.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co., The
Powell Co., The William
Sands, A. B., & Son Co.
Tiebout, W. & J.
Williams, Wm. E.

Casting—Bronze
American Manganese Bronze Co.
American Steel Foundries
Charleston Dry Dock & Machine Co.
Chase Metal Works
Chase Rolling Mill Co.
Columbian Bronze Co.
Crane Co., The
Ferguson-Herbert Corp'n
Lunkenheimer Co., The
Powell Co., The William
Sands, A. B., & Son Co.
Tiebout, W. & J.
Williams, Wm. E.

Castings—Brass and Bronze
Bath Iron Works

Castings—Gray Iron
Ferguson-Herbert Corpn.
Norwalk Iron Works
Williams, Wm. E.

Castings—Monel Metal
International Nickel Co.

Castings—Steel
American Steel Foundries
Bethlehem Shipbldg. Corp.
Chase Metal Works
Chase Rolling Mill Co.
Crane Co., The
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co., The
National Malleable Castings Co.
Sands, A. B., & Son Co.

Ceilings
(Cabin)
Marine Decking & Supply Co.

Centrifugal Oil Purifiers
De Laval Separator Co.

Centrifugal Pumps
Alberger Pump & Condenser Co.
Fairbanks-Morse Co.
Ingersoll-Rand Co.
Kearfott Engineering Co.
Kerr Turbine Co.
National Marine Engine Works
Westinghouse Electric & Mfg. Co.
Wheeler Manufacturing Co.
Williams, Wm. E.

Chain
Kearfott Engineering Co.
National Malleable Castings Co.

Chain Hoists and Blocks
Niles-Bement-Pond Co.
Union Hardware Co.
Williams, Wm. E.
Yale & Towne Mfg. Co.

Chain Pipe Wrenches
American Engineering Co.
Williams, Wm. E.
Williams Co., J. H.
Union Hardware Co.

Chain Stoppers
American Engineering Co.
J. S. Mundy Hoisting Engine Co.
Williams, Wm. E.

Chain Valve Wheels
Lunkenheimer Co., The
Powell Co., The William

Channels
Pollak Steel Co.

Charcoal Iron Boiler Tubes
Kearfott Engineering Co.
Parkesburg Iron Co.
Williams, Wm. E.

Check Valves—Brass and Iron
Crane Co., The
Lunkenheimer Co., The
Mott Iron Works, J. L.
Powell Co., The William
Pratt & Cady Co., Inc.
Sands & Son Co., A. B.
Watson-Stillman Co.
Williams, Wm. E.

Chemicals
(See Boiler Compounds)

Chipping Hammers
(See Pneumatic Tools)

Chisels
Williams, Wm. E.

Chisel Blanks
Cleveland Punch & Shear Works Co.
Ingersoll-Rand Co.
Keller Pneumatic Tool Co.

Chronometers
Williams, Wm. E.

Chronometer Valves
Williams, Wm. E.

Chocks
American Engineering Co.
Williams, Wm. E.

Chock Fittings
Steward Davit and Equip. Corp.

Chucks
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Keller Pneumatic Tool Co.
Williams, Wm. E.

Circular Shears
The Quickwork Co.

Circulating Pumps
Alberger Pump & Condenser Co.
Davidson Company, M. T.
De Laval Steam Turbine Co.
Fairbanks-Morse Co.
Ingersoll-Rand Co.
Warren Steam Pump Co.
Westinghouse Electric & Mfg. Co.
Wheeler Mfg. Co., C. H.
Williams, Wm. E.

Circulators
(See Boiler Circulators)

Clamps—Machinists and Tool Makers
Williams & Co., J. H.
Williams, Wm. E.

Clinch Rings
Williams, Wm. E.

Clocks
Ashton Valve Co.
American Steam Gage & Valve Mfg. Co.
Schaeffer & Budenburg Mfg. Co.
Williams, Wm. E.

Coal-Handling Machinery
Lidgerwood Mfg. Co.
McMyler Interstate Co.
Mundy, J. S., Hoisting Eng. Co.
Shepard Electric Crane & Hoist Co.

Coatings
(See Anti-Rust Coatings)

Cocks
(See Gauge Cocks)

Combined Air and Circulating Pumps
Wheeler Mfg. Co.

Companion Flanges
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Compasses
Williams, Wm. E.

Compositions
(See Ship's Compositions)

Compounds
(See Boiler Compounds)
(See Rust Cutting and Removing Fluid)

Compression Riveters
(See Power Riveters)

Condensers
Alberger Pump & Condenser Co.
denser Co.
American Engineering Co.
Bath Iron Works
Consolidated Shipbuilding Corp.
Davidson Co., M. T.
Griscom-Russell Co.
Ingersoll-Rand Co.
Kearfott Engineering Co.
National Marine Engine Works
Row & Davis, Engineers, Inc.
Warren Steam Pump Co.
Westinghouse Electric & Mfg. Co.
Wheeler Condenser & Eng. Co.
Wheeler Mfg. Co., C. H.
Williams, Wm. E.

Condenser Tubes
Chase Metal Works
Chase Rolling Mill Co.
Kearfott Engineering Co.
Wheeler Condenser & Eng. Co.
Williams, Wm. E.

Conduit Fittings
Crouse-Hinds Co.

Connecting Rods
Pollak Steel Co.
Williams & Co., J. H.

Consulting Engineers
(See Engineers, Consulting)

Conveying Machinery
Lidgerwood Mfg. Co.
McMyler Interstate Co.
Mundy, J. S. Hoisting Eng. Co.

Conveyors (Coal)
(See Conveying Machinery)

CO^2 Ice Machines
(See Conveying Dioxide Machines)

Coolers—Oil Coppers
(See Oil Coolers)

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Electric

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marks the only advance in chain making in keeping with shipbuilding progress that has brought us the great steel ships of today.

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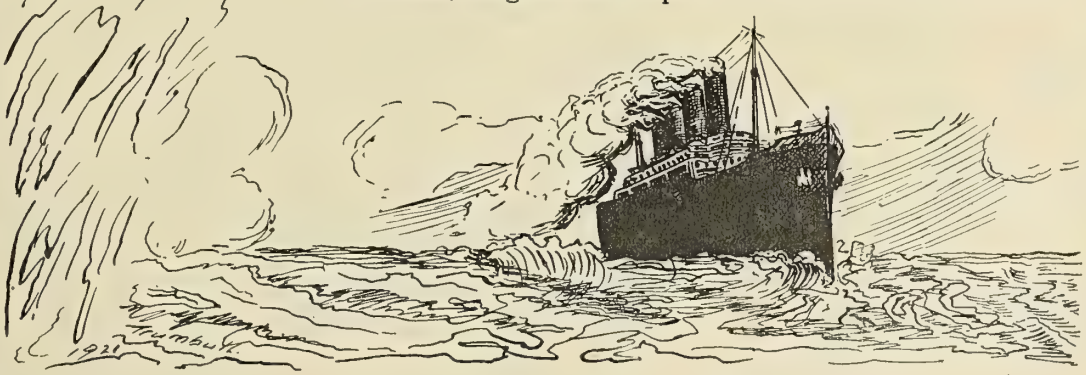
This is why Naco Chain affords the greatest protection to lives, cargoes and ships.



THE NATIONAL MALLEABLE CASTINGS CO.

CLEVELAND, OHIO

Copper
(See Brass and Copper)

Copper Tubes, Rods, Wires
Chase Metal Works
Chase Rolling Mill Co.
Williams, Wm. E.

Cordage
(Also see Rope and Wire Rope; also Twine)
American Mfg. Co.
Columbian Rope Co.
Griscom-Russell Co.
Plymouth Cordage Co.
Whitlock Cordage Co.
Williams, Wm. E.

Corrugated Furnaces
Continental Iron Works, The

Counters
(See Revolution Counters)
American Steam Gage & Valve Mfg. Co.
Schaeffer & Budenburg Mfg. Co.

Couplings
(See Hose Couplings)

Coverings—Non-Conducting
(See Non-conducting Coverings)

Cranes
(Also see Floating Cranes and Shipyards Whirlers)
American Balsa Co.
American Engineering Co.
Brown Hoisting Machinery Co.
Chambersburg Engineering Co.
McMyler Interstate Co.
Niles-Bement-Pond Co.
Shepard Electric Crane & Hoist Co.

Crank Shafts
Pollak Steel Co.
Williams & Co., J. H.

Creosoted Timbers, Piling, Etc.
Long-Bell Lumber Co.

Cutout Bases, Porcelain and Slate
Chicago Fuse Mfg. Co.

Cutters
Williams, Wm. E.

Cutting Compounds
Williams, Wm. E.

Cutting and Welding
(See Welding)

Cylinder Boring Bars
Niles-Bement-Pond Co.
Williams & Co., J. H.

Cylinder Relief Valves
(See Valves)

Cylinders for Compressed Air, Gas, Etc.
Continental Iron Works, The
National Tube Co.

Davits
American Balsa Co.
Stewart Davit & Equip. Corp.

Deck Fittings
Steward Davit & Equip. Corp.
Williams, Wm. E.

Deck Plates
Sands & Son, A. B.
Williams, Wm. E.

Deck Pumps
Sands & Son Co., A. B.
Warren Steam Pump Co.
Williams, Wm. E.

Decking
Long-Bell Lumber Co.
Marine Decking & Supply Co.

Derricks
Lidgerwood Mfg. Co.
McMyler Interstate Co.
J. S. Mundy Hoisting Engine Co.

Derrick Cars
McMyler Interstate Co.

Derrick Irons
Lidgerwood Mfg. Co.
J. S. Mundy Hoisting Engine Co.

Detaching Gear (Boat)
American Balsa Co.
Steward Davit & Equip. Corp.

Diaphragm Pumps
Hyde Windlass Co.

Die Blocks
Pollak Steel Co.

Dies
Brubaker & Bros., W. L.
Cleveland Punch & Shear Works Co.
Williams, Wm. E.

Diesel Engines
(Also see Engines, Oil)
Busch-Sulzer Bros. Diesel Engine Co.
Hadfield-Penfield Steel Co.
Kearfott Engineering Co.
McIntosh & Seymour Corp.
New London Ship & Engine Co.
Winton Engine Works

Direct-Connected Sets
(See Electrical Plants)

Direction and Revolution Indicators
Cory, Chas., & Son, Inc.

Disengaging Gears
American Balsa Co.
Steward Davit & Equip. Corp.

Distillers
(See Evaporators)

Dock Companies
American Balsa Co.

Dock Fittings
Williams, Wm. E.

Draft Gauges
American Steam Gage & Valve Mfg. Co.
Pneumercator Co.
Schaeffer & Budenburg Mfg. Co.
Williams, Wm. E.

Drain Valves
(See Valves)

Drawing Materials
(Board, Cloth, Paper, Ink, Etc.)

Dredging Machinery
American Engineering Co.
Flory Mfg. Co.
Lidgerwood Mfg. Co.
McMyler Interstate Co.
Mundy Hoisting Engine Co., J. S.

Drift Pins
Cleveland Punch & Shear Works Co.
Williams, Wm. E.

Drilling Machines
Niles-Bement-Pond Co.

Drills
Rich Tool Co.
Williams, Wm. E.

Drills, Electric
(See Electric Drills)

Drills, Pneumatic
(See Pneumatic Tools)

Drills, Portable
(See Portable Drills)

Drills, Wall Radial
(See Radial Drills)

Drop Forgings
(Eye Bolts, Wrenches, Etc.)
Pollak Steel Co.
Williams & Co., J. H.
Williams, Wm. E.

Drop Hammers
Chambersburg Engineering Co.
Niles-Bement-Pond Co.

Dry Dock Pumps
Alberger Pump & Condenser Co.
Morris Machine Works

Dry Docks
(Manufacturer and Marine Railways)
Bethlehem Shipbldg. Corp.
Crandall Engineering Co.

Dry Docks and Marine Railways
Baltimore Dry Docks & Shipbuilding Co.
Bethlehem Shipbuilding Corp., Ltd.
Charleston Dry Dock & Machine Co.
Merchant Shipbuilding Corp.
Shewan & Son, James, Co.
Staten Island Shipbuilding Corp.
Alex. Stephen & Sons, Ltd.
Sun Shipbuilding Co.
Todd Shipyards Corp.

Dynamos
(See Electric Plants)

Eccentric Rods
Pollak Steel Co.

Economizer, Fuel
(See Fuel Economizer)

Ejectors
Lunkenheimer Co.
Williams, Wm. E.

Electric Cranes
(See Electric Hoists)

Electric Cutouts
Chicago Fuse Mfg. Co.
Crouse-Hinds Co.

Electric Drills and Grinders
Chicago Pneumatic Tool Co.
General Electric Co.
Williams, Wm. E.

Electric Driven Pumps
Alberger Pump & Condenser Co.
Fairbanks-Morse Co.
Ingersoll-Rand Co.

Electric Freight Trucks
(See Freight-Handling)

Electric Fire Alarm Systems
Aero Alarm Co.

Electric Heaters
General Electric Co.

Electric Hoists
Allan-Cunningham Co.
American Engineering Co.
Brown Hoisting Machinery Co.
Chicago Pneumatic Tool Co.
General Electric Co.
Hyde Windlass Co.
Lidgerwood Mfg. Co.
Maritime Engineering & Sales Corp.
Mead-Morrison Mfg. Co.
Mundy Hoisting Eng. Co., J. S.
Niles-Bement-Pond Co
Shepard Elec. Crane & Hoist Co.

Electric Lighting
Crouse-Hinds Co.
General Electric Co.

Electric Meters
(See Meters, Electric)

Electric Plants
Consolidated Shipbuilding Corp.
Cory, Chas., & Son, Inc.
Fairbanks-Morse Co.
General Electric Co.
Kerr Turbine Co.
Westinghouse Electric & Mfg. Co.

Electric Pumps
(See Electric Driven Pumps)

Electric Welding
(See Welding, Electric)

Electrical Appliances, Installations, Fittings and Supplies
Chicago Fuse Mfg. Co.
Crouse-Hinds Co.
General Electric Co.
Williams, Wm. E.

Electrical Instruments
General Electric Co.
Williams, Wm. E.

Electrical Wiring Devices
(Switches, Sockets, Etc.)
Williams, Wm. E.

Elevators, Air and Hydraulic
(Also see Portable Elevators)

Enclosed Cartridge Fuses, Renewable and Non-renewable
Chicago Fuse Mfg. Co.

Engine Logs
Williams, Wm. E.

Engine Oil
(See Lubricants)

Engine Packing
(See Packing)

Engine Room Counters
(See Revolution Counters)

Engineers, Consulting—Marine
American Engineering Co.
Bogert, J. L.
Bonner, William T.
Cathcart, Wm. L.
Chapman & Fisher
Cox & Stevens
Crandall Engineering Co.
Donnelly, W. T.
Ferris, Theodore
Jansson & Gamon
Jacobs Co., J. L.
Haag, A. H.
Haight, Robert S.
Hansen, Max.
Harris, Leonard B.
Lysholm, Henry, Inc.
Matthews, John B.
McClelland & Co., N. E., Ltd.
McKinlay, James
McNab Co., The
Nilson, Leonard J.
Peerless Eng. Co.
Reid & Co., John
Rimmer, A. C
Row & Davis, Engineers, Inc.
Sharp, Geo. G.
Tams, Lemoine & Crane
Watts, J. Murray
Whittelsey & Whittelsey

Engines for Auxiliaries
Consolidated Shipbuilding Corp.
De Laval Steam Turbine Co.
Fairbanks-Morse Co.
Hyde Windlass Co.
Kearfott Engineering Co.
Kerr Turbine Co.
McIntosh & Seymour Corp.
Mundy Hoisting Engine Co., J. S.
New London Ship & Engine Co.
Westinghouse Electric & Mfg. Co.

Engines, Gasoline
(See Gasoline Engines)

Engines, Hoisting
(See Hoisting Engines)

Engines, Kerosene
(See Kerosene Engines)

Engines, Oil
(Also see Diesel Engines)
Busch-Sulzer Bros. Diesel Engine Co.
Chicago Pneumatic Tool Co.
Consolidated Shipbuilding Corp.
Hadfield-Penfield Steel Co.
Ingersoll-Rand Co.
Johnson Iron Works, Ltd.
Kearfott Engineering Co.
McIntosh & Seymour Corp.
New London Ship & Engine Co.
Standard Motor Construction Co.
Winton Engine Co.

Engines, Propelling
Bath Iron Works
Bethlehem Shipbuilding Corp.
Consolidated Shipbuilding Corp.
Fairbanks-Morse Co.
Hadfield-Penfield Steel Co.
Ingersoll-Rand Co.
Kearfott Engineering Co.
Los Angeles Shipbuilding & Dry Dock Co.
McIntosh & Seymour Corp.
New London Ship & Engine Co.
Standard Motor Construction Co.
Staten Island Shipbuilding Co.
Trout Co., H. G.
Ward, Chas., Engineering Works
Winton Engine Co.

Engines, Pumping
Alberger Pump & Condenser Co.
Davidson Co., M. T.
Fairbanks-Morse Co.
Griscom-Russell Co.
Kearfott Engineering Co.
Morris Machine Works
Row & Davis, Engineers, Inc.

Engine-Room Clocks
(See Clocks)

STEWARD

Life-saving Equipment

"Safety at Sea"

S.S. "AMERICA"
Equipped With Steward Davits

STEWARD DAVITS are much more than a legal requirement, they are obviously easy to operate, quick in action and are good for the life of the ship.

STEWARD LIFE BOATS are strong, able and due to correct design, acknowledged to be the most seaworthy small boat in the world.

STEWARD BOAT CHOCKS cradle the boats securely by gripping the keel in the stowed position —liberating it at a touch when needed.

STEWARD FALLS CONTROLLERS lower away the loaded boats under perfect control of one man—no chance of slipping one end first.

STEWARD BOAT RELEASING GEARS play the final part—with a single lever both ends of the boat are released easily and instantly—the boat may be afloat or several feet in the air—the operator can take advantage of the most favorable instant for releasing. A very important point in a heavy sea.

STEWARD LIFE SAVING SERVICE. At your request we will send an Engineeer to your ship to make you a detailed and strictly confidential report of the condition of your Life Saving Equipment. You will have the positive assurance that the laws have been complied with in proper form for your Legal Department and in the event of future need a dated and affirmed record will be on file for your protection. This service is too valuable for you to miss. Others are taking advantage of it.

STEWARD DAVIT & EQUIPMENT CORPORATION

17 Battery Place, New York

Factory—Hudson, N. Y.

SEATTLE
SAN FRANCISCO
LONDON

Engine-Room Supplies
(See Steam Specialties)

Engine Room Telegraphs
Williams, Wm. E.

Engrave Stem Thermometers
Taylor Instrument Companies

Evaporators
American Engineering Co.
Davidson Co., M. T.
Griscom-Russell Co.
Kearfott Engineering Co.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Exhaust Fans
(See Blowers)

Expanders
(See Boiler Flue Expanders and Pipe Expanding and Flanging Machines)

Expansion Joints
Alberger Pump & Condenser Co.
Crane Co., The
Griscom-Russell Co.
Lunkenheimer Co.
Powell Co., The William

Eye Bolts
Williams & Co., J. H.
Williams, Wm. E.

Fans
(See Blowers)

Feed Water Heaters
Alberger Pump & Condenser Co.
Griscom-Russell Co.
Kearfott Engineering Co.
Pratt & Cady Co., Inc.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Feed Water Regulators
Jerguson Gage & Valve Co.
Kearfott Engineering Co.
Pratt & Cady Co., Inc.

Fences
(See Wire Fences)

Ferrules—Condenser Tube
(See Condenser Tube Ferrules)

Files
Williams, Wm. E.

Filters—Marine Oil
Griscom-Russell Co.
Kearfott Engineering Co.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Fire Alarm Systems
Aero Alarm Co.
Kidde Co., Inc., Walter

Fire Department Supplies
Kidde Co., Inc., Walter

Fire Extinguishers
Kidde Co., Inc., Walter
Williams, Wm. E.

Fire Hose
(See Hose)

Fireproof Lumber
(See Lumber, Fireproof)

Fire Pumps
Alberger Pump & Condenser Co.
Warren Steam Pump Co.

Flags and Pennants
Williams, Wm. E.

Flanged Boiler Heads
Lukens Steel Co.

Flanges
Crane Co., The
Lunkenheimer Co., The
Williams, Wm. E.

Flanging Machines
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
Watson-Stillman Co.
Williams Co., J. H.

Floating Cranes
(Also see Cranes)
McMyler-Interstate Co.

Float Valves
Crane Co., The
Lunkenheimer Co., The

Floating Dry Docks
(See Dry Docks)

Floor Plates
Crane Co., The

Flue Cleaners
(See Boiler Flue Cleaners)

Flue Cutters
(See Boiler Flue Cutters)

Flue Hole Punches and Dies
Cleveland Punch & Shear Works Co.

Fog Horns
Williams, Wm. E.

Forced Draft
(See also Blowers)
De Laval Steam Turbine Co.
General Electric Co.
Kearfott Engineering Co.
Kerr Turbine Co.

Forges
Buffalo Forge Co.

Forgings, Bronze
Hyde Windlass Co.
Pollak Steel Co.

Forgings—Drop
(See Drop Forgings)

Forgings, Iron and Steel
(Also see Drop Forgings)
Charleston Dry Dock & Machine Co.
Pollak Steel Co.

Forgings—Monel Metal
International Nickel Co.

Freight-Handling Equipment
Brown Hoisting Machinery Co.
General Electric Co.
Lidgerwood Mfg. Co.
McMyler Interstate Co.
Mundy, J. S., Hoisting Engine Co.
Shepard Electric Crane & Hoist Co.

Fuel Economizer
Griscom-Russell Co.
Magnesia Association of America

Fuel Oil
Standard Oil Co. (New Jersey)
Sun Co.

Fuel Oil Burners
White Fuel Oil Engineering Corp.
Williams, Wm. E.

Fuel Oil Heaters
Alberger Pump & Condenser Co.
Griscom-Russell Co.
Williams, Wm. E.

Fuel Oil Pumps
Davidson Co., M. T.
Warren Steam Pump Co.

Furnace Bridge Walls
Ferguson-Herbert Corp'n
Wagner Furnace Bridge Wall Co., Inc.

Furnace Fronts
Continental Iron Works, The

Furnaces
(Also see Oil Furnaces)
Continental Iron Works, The

Fuses
Chicago Fuse Mfg. Co.
Crouse-Hinds Co.

Fusible Plugs
Crane Co., The
Griscom-Russell Co.
Lunkenheimer Co., the
Williams, Wm. E.

Galley Pumps
Mott Iron Works, J. L.
Sands & Son, Co., A. B.
Williams, Wm. E.

Galleys
(See Ranges)

Galvanized Material
Sands, A. B., & Son Co.
Tiebout, W. & J.
Williams, Wm. E.

Gantry Cranes
Niles-Bement-Pond Co.

Gas Compressors
Norwalk Iron Works

Gas Engine Specialties
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady Co., Inc.

Gas Thermometers
Schaeffer & Budenburg Mfg. Co.

Gaskets
(Also see Packing)
Crane Co., The
Goetze Gasket & Packing Co.
Griscom-Russell Co.
Williams, Wm. E.

Gasoline Engines
Consolidated Shipbuilding Corp.
Fairbanks-Morse Co.
Standard Motor Construction Co.
Winton Engine Co.

Gasoline Pumps
Sands & Son Co., A. B.

Gate Valves — Brass and Iron
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady, Inc.
Williams, Wm. E.

Gate Valves for Tank Steamers
Pratt & Cady Co., Inc.
Williams, Wm. E.

Gauge Boards
American Steam Gage & Valve Mfg. Co.
Schaeffer & Budenburg Mfg. Co.

Gauge Cocks
American Steam Gage & Valve Mfg. Co.
Jerguson Gage & Valve Co.
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady Co., The
Sands & Son Co., A. B.
Williams, Wm. E.

Gauge Glasses
Crane Co, The
Jerguson Gage & Valve Co.
Lunkenheimer Co., The
Powell Co., The William
Schaeffer & Budenburg Mfg. Co.
Williams, Wm. E.

Gauges
(See Draft Gauges; also Tank Gauges)

Gauge Testers
American Steam Gage & Valve Mfg. Co.
Schaeffer & Budenburg Mfg. Co.

Gauges—Manufacturers'
(Also see Steam Gauges)

Gears
De Laval Steam Turbine Co.
Falk Corp., The
Kerr Turbine Co.
Westinghouse Electric & Mfg. Co.

General Welding and Cutting Equipment
(See Welding & Cutting Apparatus and Supplies)

Generating Sets
Engberg's Electric & Mechanical Wks.
Fairbanks-Morse Co.
General Electric Co.
Kerr Turbine Co.
Westinghouse Electric & Mfg. Co.
Williams, Wm. E.

Generators
Crouse-Hinds Co.
Engberg's Electric & Mechanical Wks.
Fairbanks-Morse Co.
General Electric Co.
Williams, Wm. E.

Globe Valves—Brass and Iron
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Pratt & Cady Co., Inc.
Williams, Wm. E.

Glue—Marine
Williams, Wm. E.

Governor Valves
Crane Co., The
Lunkenheimer Co., The
Williams, Wm. E.

Governors
Cory, Chas., & Sons, Inc.

Grate Bars
Ferguson-Herbert Corp'n

Grease
(See Lubricants)

Grease Cups
Crane Co., The
Lunkenheimer Co., The
Powell Co., The William
Sun Co.

Grease Extractors
American Steam Gage & Valve Mfg. Co.
Griscom-Russell Co.
Row & Davis, Engineers, Inc.
Williams, Wm. E.

Grinders—Electric and Pneumatic
Chicago Pneumatic Tool Co.

Guillotine Shears
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.

Guy Anchors
Crouse-Hinds Co.

Gypseys
American Engineering Co.
Hyde Windlass Co.
Lidgerwood Mfg. Co.
Mundy Hoisting Engine Co., J. S.

Hammers
Bradley & Son, C. C.

Hammers, Pneumatic
(See Pneumatic Tools)

Hammers, Steam
Chambersburg Eng. Wks.
Niles-Bement-Pond Co.

Hammocks
(See Couch Hammocks)

Handles (Crank, Balance, Machine)
Williams & Co., J. H.

Hardware
(See Marine Hardware)

Hardwood
(See Lumber)

Hawse Pipes
Ferguson-Herbert Corp'n

Hawser Reels
Williams, Wm. E.

Hawsers—Manila
(Also see Rope and Wire Rope)
American Mfg. Co.
Columbian Rope Co.
Plymouth Cordage Co.
Whitlock Cordage Co.
Williams, Wm. E.

Heat Insulation
(Also see Non-Conducting Coverings)
American Balsa Co.
Magnesia Association of America

Heaters
(Bath, Lavatory, Shower)
Alberger Pump & Condenser Co.
Griscom-Russell Co.
Kearfott Engineering Co.
Mott Iron Works, J. L.
Pratt & Cady Co., The
Sands & Son Co., A. B.
Williams, Wm. E.

Hemp
(See Twine)

Hoist Hooks
Williams, J. H., & Co.
Williams, Wm. E.

Hoisting Engines
Allan-Cunningham Co.
American Engineering Co.
Fairbanks-Morse Co.
Flory Manufacuring Co., S.
Hadfield-Penfield Steel Co.
Hyde Windlass Co.
Lidgerwood Mfg. Co.
Maritime Engineering & Sales Corp.
Mundy Hoisting Engine Co., J. S.

BUNKER FUEL OIL

This Company is in a position to offer to the Shipping interests world-wide facilities for bunkering with "Standard" Fuel Oil. This service makes possible the decided economies resulting from the use of "Standard" Fuel Oil.

Ports at which deliveries can be made through arrangements with the Standard Oil Company (New Jersey), 26 Broadway, N. Y.

UNITED STATES

Atlantic and Gulf Ports

*New York — *Norfolk
Boston — *Charleston
*Philadelphia — *New Orleans
*Baltimore — *Baton Rouge

Pacific Coast Ports

Tacoma — *San Francisco
*Seattle — *San Pedro
*Point Wells — *San Diego
Astoria — *Honolulu
*Richmond

CANADA

*Halifax — *Vancouver
*Montreal — Prince Rupert
*Levis (Quebec)

MEXICO

Tampico

PANAMA CANAL

Cristobal — *Balboa

WEST INDIES

Havana — Bermuda
Cienfuegos — Curacao
Nuevitas — St. Thomas
San Juan

SOUTH AMERICA

Rio de Janeiro — Montevideo
*Buenos Aires — Valparaiso
*Campana — *Talara

*Diesel oil also available

UNITED KINGDOM

*Purfleet — *Liverpool
*Manchester — *Brixham
*Southampton — *Hull
*Newcastle-On-Tyne
*Sunderland — *Thames Haven

GERMANY

Hamburg — Nordenham

AFRICA

Bizerta

TURKEY

Constantinople

GREECE

Piraeus

CHINA

Hong Kong — Shanghai

JAPAN

Itosaki

Arrangements will shortly be completed to cover ports in addition to those listed, as follows:

Toronto, Ont.
Fort William, Ont.
Hamilton, Ont.
Sarnia, Ont.
Quebec (P. Q.)
St. John, N. B.
Victoria, B. C.
Antilla, Cuba
Matanzas, Cuba
Antofagasta, Chile
Iquique, Chile
Pisagua, Chile
Tocopilla, Chile
Taltal, Chile
Paita, Peru
Callao, Peru
Bahia Blanca, Arg.
Ponta Delgada, Azores
Trondhjem, Norway
Bergen, Norway
Christiania, Norway
Vallo, Norway
Gothenburg, Sweden
Helsingfors, Finland
Aalborg, Denmark
Copenhagen, Denmark
Nyborg, Denmark
Avonmouth, U. K.
Birkenhead, U. K.
Cardiff, U. K.
Rotterdam, Holland
Amsterdam, Holland
Antwerp, Belgium
Rouen, France
Havre, France
Marseilles, France
Dunkirk, France
La Pallice, France
Genoa, Italy
Monopoli, Italy
Portici, Italy
Savona, Italy
Venice, Italy
Salonica, Greece
Bourgas, Bulgaria
Smyrna, Turkey
Port Said, Egypt
Alexandria, Egypt
Colombo, Ceylon
Singapore, S. S.
Nagasaki, Japan
Sydney, Australia
Wellington, N. Z.
Durban, S. A.

STANDARD OIL COMPANY (New Jersey)

26 Broadway, New York

Hoisting and Transmission Rope
(See Rope)

Hoists, Chain
(See Chain Hoists)

Hoists, Electric
(See Electric Hoists)

Holders-On
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hollow Boring
Pollak Steel Co.

Horizontal Punches
Cleveland Punch & Shear Works Co.

Hose
(Also see Air Hose)
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hose Coupling
Chicago Pneumatic Tool Co.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

Humidifiers
Griscom-Russell Co.

Hydraulic Fittings
Crane Co., The
Lunkenheimer Co.
Powell Co., The William
Watson-Stillman Co.

Hydraulic Presses and Other Machinery
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
Warren Steam Pump Co.
Watson-Stillman Co.

Hydraulagraph
American Steam Gage & Valve Mfg. Co.

Hydrometers
Taylor Instrument Companies

Hygrodeiks
Taylor Instrument Companies

Hygrometers
Taylor Instrument Companies

Ice Machines
(See Refrigerating Machinery)

Indicator Connections
Lunkenheimer Co.
Powell Co., The William

Indicators
(Steam and Gas Engine)
American Steam Gage & Valve Mfg. Co.
Ashton Valve Co.
Cory, Chas., & Son, Inc.
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Indicating & Recording Thermometers
Schaeffer & Budenburg Mfg. Co.

Taylor Instrument Companies

Inspectors Outfits
American Steam Gage & Valve Mfg. Co.

Injectors
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Interlocking Rubber Tiling
Griscom-Russelll Co.

Iron Pipe
(See Pipe)

Iron Rust Remover
The Rust Products Co.

Jacks
(Pneumatic)
Gracey, R., & Sons Co.
Watson-Stillman Co.

Jacks, Hydraulic
Watson-Stillman Co.

Jacks—Steamboat Ratchet
(Pulling)
Gracey, R., & Sons Co.
Griscom-Russell Co.

Journal Bearings
(See Thrust Bearings)

Jute
American Mfg. Co.
Columbian Rope Co.

Kerosene Engines
Consolidated Shipbuilding Corp.
Fairbanks-Morse Co.
Standard Motor Construction Co.

Knife Switches
Crouse-Hinds Co.

Ladder Treads
Williams, Wm. E.

Lamps, Signals and Fixtures
General Electric Co.
Sands, A. B. & Son Co.
Westinghouse Electric & Mfg. Co.
Williams, Wm. E.

Lathe Dogs
Williams & Co., J. H.
Williams, Wm. E.

Lathes, Crank Shaft, Engine and Turret
Niles-Bement-Pond Co.

Launches and Yachts
(See shipbuilders)

Launching Grease
Sun Co.

Lavatories
(Stateroom)
Crane Co., The
Mott Iron Works, J. L.
Sands, A. B., & Son Co.
Williams, Wm. E.

Lavatory and Bath Heaters
Griscom-Russell Co.
Sands, A. B., & Son Co.
Williams, Wm. E.

Lead Pencils
(See Drawing Pencils)

Leather Belting
Williams, Wm. E.

Life Boats and Rafts
American Balsa Co.
Lane Lifeboat Co., C. M.
Steward Davit & Equip. Corp.
Williams, Wm. E.

Life Preservers
American Balsa Co.
Williams, Wm. E.

Life-Saving Devices
American Balsa Co.
Steward Davit & Equip. Corp.

Lighting Sets
(See Electric Plants)

Lights, Electric
(See Electric Lights)

Lines—Towing, Buoy
(See Rope)

Loading and Unloading Equipment
(See Freight-Handling Equipment)

Locks and Latches
(See Ship Locks and Latches)

Locomotive Cranes
(See Cranes)

Lowering Control
American Balsa Co.

Log Registers
American Balsa Co.
Steward Davit & Equip. Corp.

Lubricants
Standard Oil Co. (New Jersey)
Sun Co.
Wadsworth, Howland & Co.

Lubricating Oil Pumps
Warren Steam Pump Co.

Lubricators
Crane Co.
Griscom-Russell Co.
Lunkenheimer Co.
Powell Co., The William
Sun Co.

Lumber
Long-Bell Lumber Co.

Machine Tools
Cleveland Pneumatic Tool Co.
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.

Machinists' Tools
Williams & Co., J. H.

Manganese Bronze Castings
American Manganese Bronze Co.
Columbian Bronze Corp.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co.
Powell Co., The William

Magnesia Goods and Materials
Magnesia Association of America

Malleable and Steel Castings
Crane Co.

Manila and Sisal Rope
(See Rope)

Manifolds
Cleveland Pneumatic Tool Co.

Manufacturing Plants
(See Builders)

Marine Boiler Heads
(See Boiler Heads)

Marine Cableways
Lidgerwood Mfg. Co.

Marine Coatings
(See Anti-Rust Coastings)

Marine Decking
(See Decking)

Marine Electrical Equipment
(See Electrical Fittings and Supplies)

Marine Engines
(See Engines, Propelling)

Marine Engineers
(See Engineers, Consulting)

Marine Forgings
(See Forgings)

Marine Glue
Williams, Wm. E.

Marine Hardware
Consolidated Shipbuilding Corp.
Sands & Son Co., A. B.
Tiebout, W. & J.
Williams, Wm. E.

Marine Heaters
(See Heaters)

Marine Lighting Sets
(See Electric Plants)
Williams, Wm. E.

Marine Paint
(Also see Paint)
Briggs Bituminous Composition Co., Inc.
Federal Composition & Paint Co., Inc.
Wadsworth, Howland & Co.
Wailes Dove - Hermiston Corp.
Williams, Wm. E.

Marine Plumbing
Crane Co., The
Mott Iron Works, J. L.
Sands & Son Co., A. B.

Marine Railway Builders
Crandall Engineering Co.

Marine Railways
(See Dry Docks)

Marine Ranges
(See Ranges)

Marine Refrigeration
(See Refrigerating Machinery)

Marine Repairs
(See Shipbuilders)

Marine Securities
Marine Corporation

Marine Shafting
(See Shafting)

Marine Specialties
(See Steam Specialties)

Marine Superheaters
Babcock & Wilcox Co.
Heine Safety Boiler Co.
Power Specialty Co.
Superheater Co., The

Marine Supplies
Tiebout, W. & J.
Williams, Wm. E.

Marine Wiring Devices
General Electric Co.

Masts, Tubular Steel
National Tube Co.

Mattresses
Southern-Rome Co.

Mechanical Telegraphs
Radio Corporation of America
Williams, Wm. E.

Mercury Pressure Gauges
American Steam Gage & Valve Mfg. Co.

Metallic Packing
(Also see Packing)
Goetze Gasket & Packing Co.
U. S. Metallic Packing Co.

Meters, Electric
General Electric Co.

Mica Top Fuse Plugs
Chicago Fuse Mfg. Co.

Milling Machines
Niles-Bement-Pond Co.

Mineral Wool
(See Non-Conducting Covering)

Monel Metal
International Nickel Co.

Mooring Engines
American Engineering Co.
Flory Mfg. Co., S.
Hyde Windlass Co.
Lidgerwood Mfg. Co.

Motor Boats
(See Launches and Yachts)

Motor Boat Supplies
Tiebout, W. & J.
Williams, Wm. E.

Motors, Electric
General Electric Co.

Motors, Gasoline
(See Gasoline Engines)

Multiple Drills
Niles-Bement-Pond Co.

Multiple Punches
Cleveland Punch & Shear Works
Niles-Bement-Pond Co.

Multiwhirl Oil Coolers
Griscom-Russell Co.

Nautical Instruments
McNab Co., The
Williams, Wm. E.

Naval Architects
Bogert, John L.
Cathcart, Wm. L.
Chapman & Fisher
Cox & Stevens
Donnelly, William T.
Ferris, Theodore
Jansson & Gamon
Jacobs Co., J. L.
Haag, A. H.
Haight, Robert S.
Hansen, Max
Harris, Leonard B.
Lysholm, Henry, Inc.
McClelland, N. E., & Co., Ltd.
McKinlay, James
Matthews, John B.
Nilson, Leonard J.
Peerless Eng. Co.
Rimmer, A. C.
Sharp, Geo. G.
Tams, Lemoine & Crane
Watts, J. Murray
Whittelsey & Whittelsey

Needle Valves
(See Valves)

Nipples
Crane Co., The
Lunkenheimer Co., The

Non-Conducting Coverings
Magnesia Association of America
Thorsen, P. S., & Co., Inc.

Non-Toppling Blocks
American Balsa Co.

Nozzles
(See Hose Nozzles)

Nuts
(See Bolts and Nuts)
Russell, Burdsall & Ward Bolt and Nut Co.
Williams, Wm. E.

Oakum
American Balsa Co.
American Mfg. Co.

What Balsa Insulation Means to the Shipowner and Shipbuilder

BALSA insulation, economical in maintenance of refrigerated ship spaces and practical in the simplicity of its installation, provides the solution for the many difficulties heretofore encountered in construction and upkeep. By the use of Balsa full insulating values are maintained, without replacement, year after year; there is a saving of as much as fifty percent of the weight of the insulating structure; thinner walls increase the available cargo space; and the original cost of the completed structure is less than with other good materials.

In the last eighteen months more than a million board feet of Balsa insulation have been installed following the thorough development of its use during the last ten years. Methods of treatment that retain the high insulating value of this lightest of all woods, have been fully proven. Standard plans of installation have been established. Balsa has met successfully all those tests and conditions to which an extended period of actual use has subjected it. Its use has brought about a new appreciation of the possibilities of economical ship insulation.

ADVANTAGES OF BALSA SHIP INSULATION

1 Balsa is supplied in large panels having a structural strength fully half that of spruce.

2 Balsa requires little studding and only a single layer of sheathing for surface protection.

3 Its resistance to heat transmission is equal to that of other high grade insulating materials.

4 Balsa is even lighter than cork, and the weight of a completed installation is fully 50% less.

5 Permanence of structure and of insulating efficiency is obtained through exclusion of moisture.

6 Balsa panels are easily installed, a small number of tight fitting joints minimizing heat leakage.

7 Removable sections can be installed to permit ready inspection of ship's hull for painting or repairs.

8 Metal sheathed Balsa panels are available for insulation of boiler room hatches and crew quarters.

An article which appeared in the July, 1921, issue of International Marine Engineering, describing Balsa ship insulation, and including detailed drawings showing standard plans of installation, has been reprinted for distribution to those interested. May we send you a copy of this article?

American Balsa Company *Inc.*

50 East Forty-second Street, New York

Stratford Oakum Co., George
Wall Rope Works, Inc.

Oil
(See Lubricants)

Oil Burners, Fuel
(See Fuel Oil Burners)

Oil Burning Equipment
Bethlehem Shipbldg. Corp.
Pommer, Walter C.
White Fuel Oil Engineering Corp.
Williams, Wm. E.

Oil Coolers
Alberger Pump & Condenser Co.
Griscom-Russell Co.

Oil Cups
Crane Co.
Griscom-Russell Co.
Lunkenheimer Co., The
Powell Co., The William
Sun Co.
Williams, Wm. E.

Oil Engines
(See Engines, Oil)

Oil Fuel
Standard Oil Co. (New Jersey)
Sun Co.

Oil Fuel Apparatus
(See Oil-Burning Equipment)

Oil Gauges
Crane Co.
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Oil Heaters and Coolers
Alberger Pump & Condenser Co.
Griscom-Russell Co.
Row & Davis, Engineers, Inc.

Oil Pumps
Davidson, M. T., Co.
Ingersoll-Rand Co.
Lunkenheimer Co., The
Powell Co., The William
National Transit Pump & Machine Co.
Sands, A. B., & Son, Co.
Warren Steam Pump Wks.

Oil Purifiers
De Laval Separator Co.
Griscom-Russell Co.

Oil Tankers
(See Tank Ships)

Oiling Systems
(Also see Lubricants)
Lunkenheimer Co., The
Powell Co., The William

Old Code Fuses, All Types
Chicago Fuse Mfg. Co.

Open Link Fuses, All Types
Chicago Fuse Mfg. Co.

Ore-Handling Machinery
(See Coal-Handling Machinery)

Outlet Boxes and Covers
Chicago Fuse Mfg. Co.

Oxy-Acetylene Welding and Cutting
Prest-O-Lite Co., Inc.
Vulcan Iron Works, Inc.

Oxygen
Linde Air Products Co.
Prest-O-Lite Co.

Packing
(Also see Metallic Packing and Ammonia Packing)
Goetz Packing Co.
United States Metallic Packing Co.
Williams, Wm. E.

Packing, Asbestos
Crane Co.
Williams, Wm. E.

Packings, Leather
Watson-Stillman Co.

Paint
Federal Composition & Paint Co.
Marine Decking & Supply Co.
Wadsworth, Howland & Co.
Wailes Dove-Hermiston Corp.
Williams, Wm. E.

Paint Spraying Equipment
(See Pneumatic Paint Spraying Equipment)

Panel Boards
(Marine)
Crouse-Hinds Co.

Panelling
(Marine Fireproof)
Marine Decking & Supply Co.

Pantographs
American Steam Gage & Valve Mfg. Co.

Partitions
(Marine Fireproof)
Marine Decking & Supply Co.

Pencils
(See Drawing Pencils)

Phosphor Bronze Castings
American Manganese Bronze Co.
Columbian Bronz Corp.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co., The

Pile Drivers
Flory, S., Mfg. Co.
Lidgerwood Mfg. Co.
McMyler-Interstate Co.
Mundy Hoisting Eng. Co., J. S.

Pipe
National Tube Co.
Watson-Stillman Co.
Williams, Wm. E.

Pipe Bending Machines
Buffalo Forge Co.
Watson-Stillman Co.

Pipe Covering
(See Non-Conducting Covering)

Pipe Cutting and Threading Machine
Niles-Bement-Pond Co.
Williams, Wm. E.

Pipe Expanding and Flanging Machines
Watson-Stillman Co.

Pipe Flanges
(See Flanges)

Pipe Unions
Crane Co.
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Pipe Wrenches
Williams & Co., J. H.
Williams, Wm. E.

Piston Rings
(See Packings)

Piston Rods
Pollak Steel Co.

Planers
(Metal Working)
Cleveland Pneumatic Tool Co.
Niles-Bement-Pond Co.

Planimeters
American Steam Gage & Valve Mfg. Co.
Williams, Wm. E.

Plate-Bending Rolls
(See Rolls, Bending & Straightening)

Plate Castors
(See Castors)

Plate Shears
The Quickwork Co.

Plates
(See Steel Plates and Shapes)

Plugs and Receptacles—Watertight
Williams, Wm. E.

Plumbago
(Also see Graphite)
Williams, Wm. E.

Plumbers' Tools
Williams & Co., J. H.
Williams, Wm. E.

Plumbing
(See Marine Plumbing)

Pneumatic Drills
(See Pneumatic Tools)

Pneumatic Hammers
(See Pneumatic Tools)

Pneumatic Hose
(See Air Hose)
Sands, A. B., & Son, Co.

Pneumatic Riveters
Ingersoll-Rand Co.
Watson-Stillman Co.

Pneumatic Separators
Griscom-Russell Co.

Pneumatic Tools
Cleveland Pneumatic Tool Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Pop Safety Valves
American Steam Gage & Valve Mfg. Co.
Ashton Valve Co.
Crane Co.
Lunkenheimer Co., The
Powell Co., The William
Williams, Wm. E.

Poppet Valves
(See Valves)

Portable Drills
General Electric Co.

Portable Elevators
(For Handling Bulk Materials)

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(See Air Ports)

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The Quickwork Co.

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Watson-Stillman Co.

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Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.

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Ingersoll-Rand Co.
Niles-Bement-Pond Co.
Watson-Stillman Co.

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Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.
Quickwork Co.

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(See Hydraulic Presses)

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Schaeffer & Budenburg Mfg. Co.

Pressure Regulators
Ashton Valve Co.
Crane Co.
Lunkenheimer Co., The
Powell Co., The William

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Aero Alarm Co.
Ansell & Bailey
Bogert, John L.
Bonner, William T.
Cathcart, Wm. L.
Chapman & Fisher
Ferris, Theodore
Jacobs Co., J. L.
Jansson & Gamon
Haag, A. H.
Haight, Robert S
Lysholm, Henry, Inc.
Matthews, John B.
McClelland, N. E., & Co., Ltd.
Nilson, Leonard J.
Pommer, Walter E.
Tams, Lemoine & Crane
Peerless Eng. Co.
Sharp, Geo. G.
Watts, J. Murray
Whittelsey & Whittelsey

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(See Searchlights)

Propeller Shafts
(See Shafting)

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American Manganese Bronze Co.
Bethlehem Shipbldg. Corp.
Columbian Bronze Corp.
Donnelly, Wm. T.
Ferguson-Herbert Corp'n
Hyde Windlass Co.
Kearfott Engineering Co.
Trout Co., H. G.

Pump Governors
Williams, Wm. E.

Pumping Machinery
(See Engines, Pumping)

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Alberger Pump & Condenser Co.
Bethlehem Shipbldg. Corp.
Chambersburg Engineering Co.
Davidson Co., M. T.
De Laval Steam Turbine Co.
Fairbanks-Morse Co.
Griscom-Russell Co.
Hyde Windlass Co.
Ingersoll-Rand Co.
Kerr Turbine Co.
National Transit Pump & Machine Co.
Row & Davis, Engineers, Inc.
Sands & Son, Co., A. B.
Warren Steam Pump Co.
Watson-Stillman Co.
Wheeler Condenser & Eng. Co.
Wheeler Mfg. Co., C. H.
Westinghouse Electric & Mfg. Co.
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(See Power Punches)

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(See Spacing Tables)

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Superheater Co., The
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(See Davits)

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Radio Corporation of America

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(See Lifeboats and Rafts)

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Crandall Engineering Co.

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Brubaker & Bros., W. L.
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De Laval Separator Co.

Recording Instruments
(Also see Steam Gauges)
Taylor Instrument Companies

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(See Gears)

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Lunkenheimer Co., The
Williams, Wm. E.

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Frick Co.
Norwalk Iron Works
Westinghouse Electric & Mfg. Co.
York Mfg. Co.

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Lunkenheimer Co.
Powell Co., The William
Sands, A. B., & Son, Co.
Williams, Wm. E.

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Steward Davit & Equip. Corp.

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Ashton Valve Co.
Crane Co.
Lunkenheimer Co., The
Powell Co., The William
Watson-Stillman Co.
Williams, Wm. E.

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Bethlenem Shipbldg. Corp.
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You don't have to be a metallurgist to discover that Cameron Pumps are made of high grade materials throughout.

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Schaeffer & Budenburg Mfg. Co.
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(See Rope; also Wire Rope)

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(See Shipbuilders)

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Champion Rivet Co.
Severance Mfg. Co., S.

Rivet Busters, Rivet Clamps and Rivet Tongs
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

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(See Pneumatic Riveters and Power Riveters)

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(Also see Power Riveters and Pneumatic Riveters)
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Chicago Pneumatic Tool Co.
Niles-Bement-Pond Co.

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Chase Metal Works
Chase Rolling Mill Co.
Williams, Wm. E.

Rods (Steel)
Pollak Steel Co.

Rods, Welding
(See Welding Rods)

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Williams, Wm. E.

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Bantam Ball Bearing Co.

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Cleveland Punch & Shear Works Co.
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Whitlock Cordage Co.

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Quickwork Co., The

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(See Launches and Yachts)

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(See Interlocking Rubber Tiling)

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The Rust Products Co.

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(See Life Saving Devices)

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(See Valves)

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(See Plumbing)

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Sands, A. B., & Son, Co.
Warren Steam Pump Co.

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(See Steel Shafting)

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Kearfott Engineering Co.
National Tube Co.
Pollak Steel Co.
Williams, Wm. E.

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Chase Rolling Mill Co.

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Consolidated Shipbuilding Corp.
Johnson Iron Works, Ltd.
Merchant Shipbuilding Corp.
New London Ship & Engine Co.
New York Shipbuilding Corp.
Shewan & Son, James, Co.
Standard Motor Construction Co.
Staten Island Shipbuilding Co.
Stephen & Sons, Alex., Ltd.
Sun Shipbuilding Co.
Todd Shipyards Corp.
Vulcan Iron Works, Inc.
Ward, Chas., Engineering Works

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(See Cranes)

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Bogert, John L.
Cox & Stevens
Ferris, Theodore
Haight, Edward S.
Maritime Engineering & Sales Corp.
McClelland, N. E., & Co., Inc.
Pommer, Walter E.
Watts, J. Murray

Ship Chandlers
Williams, Wm. E.

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(See Clocks)

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Wailes Dove-Hermiston Corp.

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(See Cowls)

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(See Marine Glue)

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(See Rivets)

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(See Lumber)

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(See Cranes)

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(See Cranes)

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(See Cranes)

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(See Taps and Dies)

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Lunkenheimer Co.
Powell Co., The William
Taylor Instrument Companies
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(See Hoisting Engines)

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(See Marine Superheaters)

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Pratt & Cady Co., Inc.
Sands, A. B., & Son Co.
Williams, Wm. E.

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Bath Iron Works
Bethlehem Shipbuilding Corp.
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General Electric Co.
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Vulcan Iron Works, Inc.
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(See Steel Plates and Shapes)

Steel Plate Construction
Heine Safety Boiler Co.

Steel Plates and Shapes
Lukens Steel Co.

Steel Shafting
(See Shafting)

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Heine Safety Boiler Co.

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Hadfield-Penfield Steel Co.
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Mundy Hoisting Engine Co., J. S.

Steering Gears
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BOILER RIVETS
ON EVERY HEAD

MAIN OFFICE & WORKS
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WESTERN PLANT
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THE CHAMPION RIVET COMPANY

CLEVELAND, O.

THE CHAMPION RIVET COMPANY

COLD-MADE RIVETS

There is a difference in cold-made rivets.

Victor Rivets are made in solid dies.

Fig. 1.

Avoid the use of cold-made rivets (made on open-die machines) with fins under head. When driven, this fin causes a leaky joint, especially on pressure work.

Heads may have offsets and shanks may be out of round.

Cultivate the use of cold-made rivets made on solid die machines—free from fins—smooth under the head and round shanks.

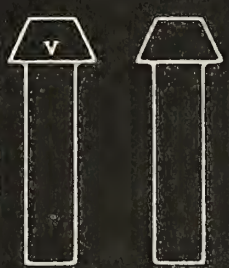

Fig. 2.

Victor Rivets make tight joints without caulking.

THE CHAMPION RIVET COMPANY

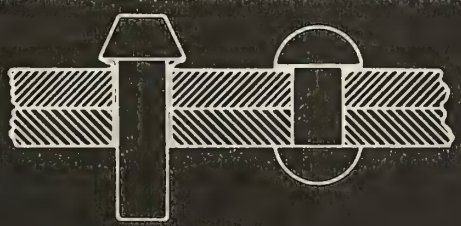

Fig. 3.

This illustration shows the effect of the fins before and after driving.

The effect on the finished work is obvious.

The offset due to the mis-matching of the halves of the die in cold-made work, as shown in illustration No. 1, adds to the difficulty in getting a tight rivet.

Avoid unfavorable conditions by using Victor solid die rivets.

Straightening Rolls
(See Rolls)

Superheaters
(See Marine Superheaters)

Superheater Tubes
National Tube Company

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Wheeler Mfg. Co., C. H.
Williams, Wm. E.

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Swivels
Williams, Wm. E.

Tachometers
(See Electric Tachometers)
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Tachoscopes
Schaeffer & Budenburg Mfg. Co.

Tackle Blocks
Williams, Wm. E.

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(See Shafting)

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Griscom-Russell Co.
Sands, A. B., & Sons Co.

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Pneumercator Co.

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Baltimore Dry Docks & Shipbuilding Co.
Bath Iron Works
Merchant Shipbuilding Corp.

Tank Pumps
Davidson Co., M. T.
Warren Steam Pump Co.

Tanks, Seamless Steel
Continental Iron Works, The
National Tube Co.

Tanks, Welded Steel
Continental Iron Works, The

Taps and Dies
Brubaker, W. L., & Bros.
Williams, Wm. E.

Tarred Hemp Rope
American Mfg. Co.
Wall Rope Works
Whitlock Cordage Co.
Williams, Wm. E.

Tees—Rolled Steel
Pollak Steel Co.

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(See Mechanical Telegraphs)

Telegraph Fittings and Voice Tubes and Fittings
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Telemotors—Electric and Hydraulic
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American Engineering Co.
Hyde Windlass Co.
Maritime Engineering & Sales Corp.
Mundy Hoisting Engine Co., J. S.

Telephones and Telephone Apparatus
(Also see Ship Telephones)
Radio Corp. of America

Temperature and Pressure Regulators
Taylor Instrument Companies

Test Thermometers
Schaeffer & Budenburg Mfg. Co.

Tested Fuse Wire and Strip
Chicago Fuse Mfg. Co.

Thermit Welding
Powell Co., The William

Thermometers
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Schaeffer & Budenburg Mfg. Co.
Taylor Instrument Companies
Williams, Wm. E.

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(See Interlocking Rubber Tiling)

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(See Machine Tools)

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Towing Lines
(See Rope and Wire Rope)

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Union Hardware Co.

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American Engineering Co.
Lidgerwood Mfg. Co.
Maritime Engineering & Sales Corp.

Trainographs
American Steam Gauge & Valve Mfg. Co.

Transmission Rope
(See Rope)

Traps
(See Steam Traps)

Traveling Cranes
(See Cranes)

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McMyler Interstate Co.

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(See Boiler Tubes; also Condenser Tubes)

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Chase Rolling Mill Co.
International Nickel Co.
Williams, Wm. E.

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(See Boiler Flue Cleaners)

Tube Expanders
(See Boiler Flue

Tugs
(See Shipbuilders)

Turbines
(See Steam Turbines)

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Williams & Co., J. H.
Williams, Wm. E.

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(See Lathes, Turret)

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(See Rope; also Cordage)
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Columbian Rope Co.
Plymouth Cordage Co.
Whitlock Cordage Co.
Williams, Wm. E.

Twist Drills
Williams, Wm. E.

Unions
(See Pipe Unions)

Upholstery
(See Ship Upholstery)

Vacuum Gauges
(See Steam Gauges)

Vacuum, Pressure and U Gauges
Taylor Instrument Companies

Vacuum Pumps
Alberger Pump & Condenser Co.
Davidson, M. T., Co.
Ingersoll-Rand Co.
Warren Steam Pump Co.
Westinghouse Electric & Mfg. Co.
Wheeler Mfg. Co.

Vacuum Traps
Crane Co., The
Griscom-Russell Co.
Williams, Wm. E.

Valve Discs
Goetze Gasket & Packing Co.

Valve Reseating Machines
Leavitt Machine Co.

Valves
Ashton Valve Co.
Bethlehem Shipbldg. Corp.
Crane Co.
Griscom-Russell Co.
Jerguson Valve Mfg. Co.
Lunkenheimer Co.
Powell Co., The William

Valves (Automatic Relief)
Pratt & Cady Co., Inc.
Sands, A. B., & Son Co.
Watson-Stillman Co.
Williams, Wm. E.

Valves, Ammonia and Carbon Dioxide
Frick Co.
Pratt & Cady Co., Inc.
York Mfg. Co.

Valves—Chronometer
(See Chronometer Valves)

Valves—Rubber
Powell Co., The William
Pratt & Cady Co., Inc.
Sands, A. B., & Son Co.
Williams, Wm. E.

Valves—Water
Chambersburg Engineering Co.
Crane Co.
Jerguson Gage & Valve Co.
Lunkenheimer Co.
Powell Co., The William
Sands, A. B., & Son Co.
Williams, Wm. E.

Vapor Proof Fittings
(See Waterproof Fittings)

Ventilating Fans
(See Blowers)

Ventilators
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Vertical Pumps
(See Pumps)

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(See Ship Brokers)

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Williams & Co., J. H.
Williams, Wm. E.

Voice Tubes and Fittings
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Chase Rolling Mill Co.

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(See Radial Drills)

Water Closets, Marine
(See Plumbing)

Water Columns
Crane Co.
Jerguson Gage & Valve Co.
Lunkenheimer Co.
National Tube Co.

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Crane Co.
Jerguson Gage & Valve Co.
Lunkenheimer Co.
Powell Co., The William
Schaeffer & Budenburg Mfg. Co.

Water Level Recorders
Schaeffer & Budenburg Mfg. Co.

Watertube Boilers
(See Boilers)
Heine Safety Boiler Co.
Ward Engineering Works, Chas.

Wattmeters
(See Electrical Instruments)

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(Oxy-acetylene Process)
Prest-O-Lite Co., Inc.
Vulcan Iron Works, Inc.

Welding, Electric
General Electric Co.

Welding Metals
(See Welding and Cutting Apparatus and Supplies)

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Vulcan Iron Works, Inc.

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(See Cranes)

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(American Engineering Co

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Ashton Valve Co.
Crane Co.
Lunkenheimer Co.
Powell Co., The William
Sands, A. B., & Son Co.
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Lunkenheimer Co.

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Bethlehem Shipbldg. Corp.
Maritime Engineering & Sales Corp.
J. S. Mundy Hoisting Engine Co.

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American Engineering Co.
American Ship Building Co.
Bethlehem Shipbuilding Corp.
Flory, S., Mfg. Co.
Hadfield-Penfield Steel Co.
Hallidie Co., N.
Hyde Windlass Co.
Kearfott Engineering Co.
Lidgerwood Mfg. Co.
Maritime Engineering & Sales Corp.
Mundy Hoisting Eng. Co., J. S.

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American Engineering Co.
Wickwire-Spencer Steel Corp.
Williams, Wm. E.

Wireless Apparatus and Telegraphs
Radio Corporation of America

Wiring Devices
(See Marine Wiring Devices)

Wiring Machines
The Quickwork Co.

Woodworking Machinery
Chicago Pneumatic Tool Co.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

Wrecking Cables
American Mfg. Co.
Columbian Rope Co.
Plymouth Cordage Co.
Wall Rope Works
Whitlock Cordage Co.

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Davidson Co., M. T.
Warren Steam Pump Co.

Wrenches
(Also Pipe Wrenches)
Coes Wrench Co.
Williams & Co., J. H.
Williams, Wm. E.

Yacht Brokers
(See Ship Brokers)

Yachts
(See Launches and Yachts)

Yoke Chronometers Valves
Williams, Wm. E.

Zinc Dust
Williams, Wm. E.

Zinc Plates
Williams, Wm. E.

Zinc Ship and Boiler Plates
Williams, Wm. E.

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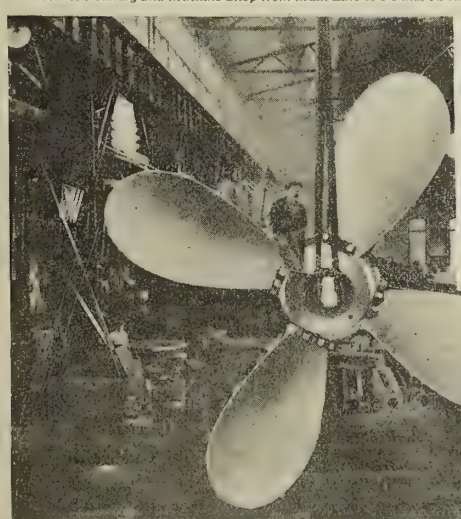
BUFFALO
63 Vulcan St.

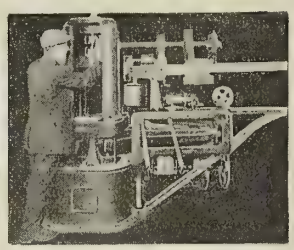
CHICAGO
1063 W. 120th St.

View of Foundry and Machine Shop from Main Line of Penna. R. R. to New York.

A few blades for an 18 ft. 6 in. diameter propeller. An order for 240 such blades was received by us.

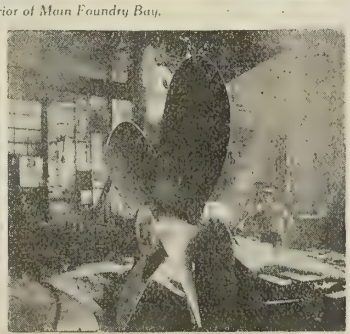


Interior of Main Foundry Bay.



View of our Tinius Olsen Testing Machine.

Showing first propeller (on an order of 40) delivered to HOG ISLAND, for use on the class "B" ships building there. Diameter 18 ft. 6 in. Weight 34,000 lbs. Manufactured by American Manganese Bronze Co.



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HOLMESBURG, PHILA., PA.

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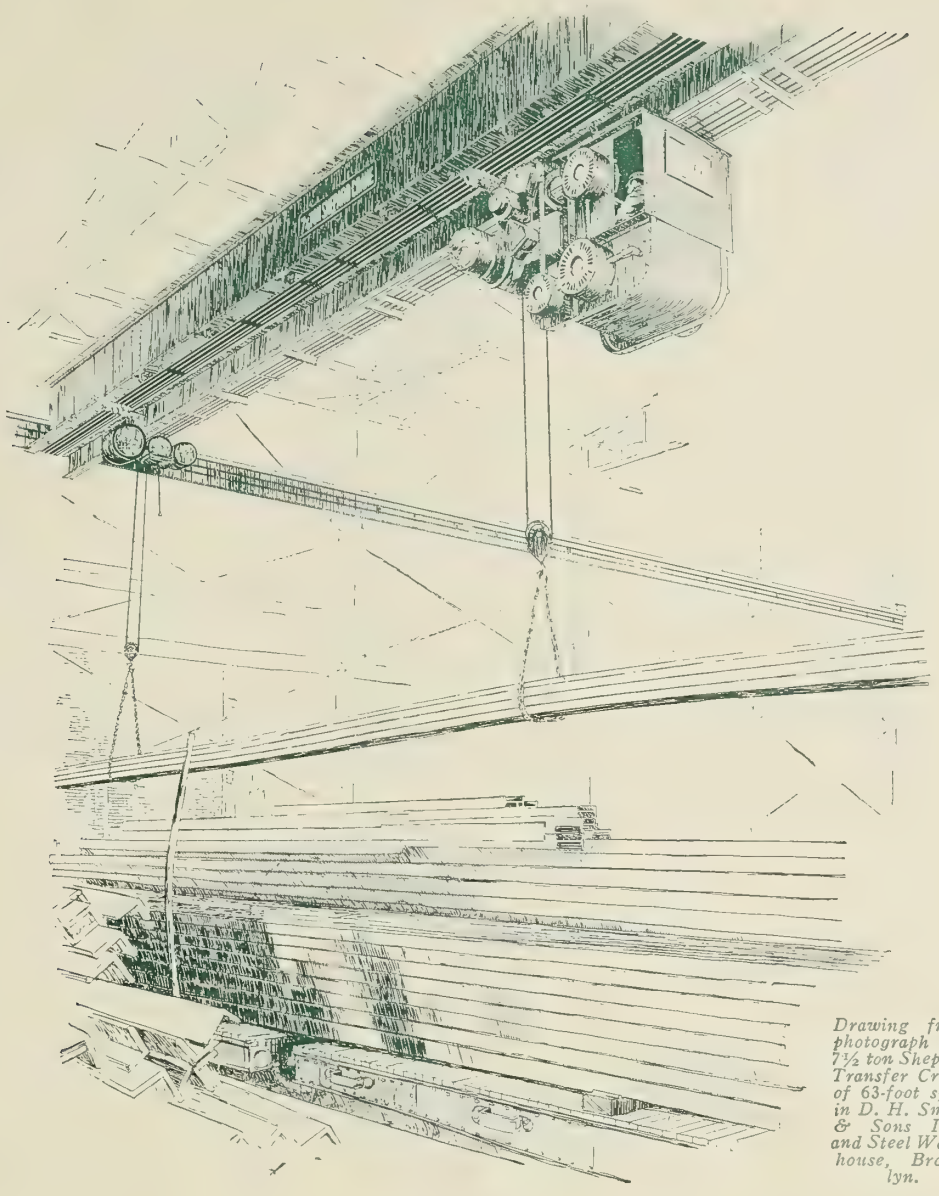

Drawing from photograph of 7½ ton Shepard Transfer Crane of 63-foot span in D. H. Smith & Sons Iron and Steel Warehouse, Brooklyn.

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